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Transmission Mechanism of Monetary Policy in Central and Eastern Europe

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1. Introduction

As more central banks across Central and Eastern Europe (CEE) move towards inflation control – either in the form of direct inflation targeting or indirectly through informal targets – good knowledge of transmission mechanism in the economy becomes crucial for implementing good policies. So far the volume of studies in the region devoted to this issue is not overly impressive. There have been no attempts made to study the issue in a comparative context of several economies.

In the case of CEE, this research field, like many others, is naturally constrained by at least two important factors. The first is the lack of data in terms of both length of time series and of quality and reliability. The second is the constant institutional changes in the studied environment which renders the different models and techniques structurally unstable and the results – generally volatile.

The purpose of this study is to review the existing literature on transmission mechanism in CEE and put it in a broader context of the problems related to research on monetary policy. Also, we attempted to conduct empirical analysis for 10 transition economies using analogous methodology for the same sample period 1995-2000. In this comparative framework a series of Granger causality tests and impulse response analysis were carried out to asses the strength of two major transmission channels: interest rate and exchange rate channel. Also in the empirical part, we tried to look for the existence of long-run relationships between the basic set of macroeconomic variables in the countries under investigation.

The paper is composed as follows. Chapter 2 briefly reviews the transmission mechanism research in CEE with special emphasis on the origin of studies, methods used and general inferences. Then, chapter 3 presents a problem-based discussion of issues related to transmission mechanism in the special context of transition economies. Goals, targets and tools of monetary policy as well a exchange rate regimes are reviewed and discussed. Chapters 4 and 5 present empirical results. Chapter 4 describes core inflation estimates and selection process as well as presents all remaining variables and tests for the level of integration. Chapter 5 includes the empirical analysis of transmission mechanism through Granger causality and impulse responses as well as cointegration analysis. Finally, chapter 7 concludes the paper with summary of results.

2. Review of Transmission Mechanism Research in CEE

Below we present the compact review of transmission mechanism research in CEE. Of course, this short review cannot encompass all papers on this subject, but a conscious attempt was made to organize a thorough observation of work done so far. More than 40 papers were reviewed, and their analysis naturally requires some initial organization. The papers can be organized along different dimensions, which include origin of the work (or affiliation of the authors), method used, focus of the analysis related to the specific channel or step of monetary transmission covered by the respective study. These aspects of the literature are overviewed first. Then some individual papers are presented in short, and finally some generalized findings of the literature so far are summarized.

Origin of the works and methods used

Because of the nature of the topic, most of the work related to monetary transmission is concentrated around the central banks of the respective countries. In the case of this study more than two thirds of the papers dealing or at least touching upon the issues of monetary transmission have been generated by, published by, or authored by people affiliated with central banks. Most of the rest concern the Baltic countries and are generated by research institutes, such as the Bank of Finland Institute for Economies in Transition (BOFIT), or the Stockholm Institute of Transition Economics (SITE) situated in Western countries and focusing on transition issues.

While the interest of central banks and regional research institutes in the topic is natural and leads to a relatively large amount of papers, the work is tailored for the needs of the specific country, region, or central bank. This renders inferences based on the fact that a particular country is in (particular stage of) transition, but it is difficult to justify them based on observations in other countries. Work which transcends the national borders in the region of Central and Eastern Europe is rare, and there have been no attempts to include the analysis of monetary transmission in all accession countries in a common framework. If such a framework is going to be built and used, however, knowledge about the approaches and findings of previous studies of different countries in the region is important.

There are at least four ways to approach the issues of monetary transmission and all of them have been used in the case of CEECs. One possible approach is to use a less formal, descriptive, graphic and comparative analyses, which deal with observation and comparisons of variables related to monetary transmission and make inferences boiling down to suggestions for stylized facts about monetary transmission. Ideally, this approach would consist of identifying shocks in the "policy", or monetary environment, variables, then develop a counterfactual (what would have happened to the outcome variables in the absence of a shock or some other valid comparison), compare the actual with the counterfactual, and draw conclusions. This is the approach adopted in several papers, such as Babich (2001) for Latvia, Korhonen (1999) and Garcia-Herrero (1997) for Estonia and Lithuania's currency boards, Vetlov (2001) for Lithuania.

The more formal approaches involve formulation and estimation of econometric models using different starting points and techniques. The starting point usually relate to basic assumptions about the way the economy works, and are often constraint by data availability in terms of both scope and length. Some formal models attempt to avoid imposition of strong theoretical constraints on the data, and use a vector autoregressive approach to make inferences about the effects of monetary policy. This type of approach includes different variations, such as vector error correction specifications, variance decompositions, Granger causality tests, etc. Along these lines are the studies of Nenovski and Hristov (1998 and 1999) for Bulgaria, Izak (1998) for the Czech Republic, Csermely and Varro (2000) for Hungary, Sarajevs (2000) for Latvia, Vetlov (2000) for Lithuania, Maliszewski (1999) and Rybiński (1997) for Poland, Pelines-

cu and Scutaru (2000a and 2000b) and Popa (1996) for Romania. This approach is fairly popular because of its lower requirements with respect to data and due to the possibility of work with looser underlying assumptions.

Other models consider specific aspects of transmission by modeling the behavior of specific agents with respect to specific policy variables, and thus use small structural macroeconomic models with at most several equations. This approach involves estimations of several equations, reaction functions, and doing simulations. This category encompasses the work of Derviz (2000) and Mahadeva and Smidkova (2001) for the Czech Republic, Pikkani (2000) for Estonia, Csajbok and Varro (2000) and Arvai and Menczel (2000) for Hungary, Delakorda (2000) and Drenovec (1999) for Slovenia.

A third type of formal studies recognize the importance of capturing various links in the monetary transmission process, and try to develop more detailed large macroeconomic models with more equations. Since the development of such a model is next to impossible in the transition context due to lack of sufficiently long data series, the only work which uses this type of approach is the combined research of Lättemäe (2001) and Pikkani (2001) for Estonia, even though the system of equations which is actually estimated is not very large and misses some potentially important sectors such as the labor market.

All methods have relative strengths and weaknesses in the transition and EU integration context. For example, a VAR may be very useful in the transition context of short data series and non-neoclassical characteristics of economic interaction which make reliance on traditional theoretical models precarious, but may have problems capturing the dynamics of institutional change related to the integration process, and has to be careful about the presence and relevance of structural breaks. The fully developed large macroeconomic models, on the contrary, have the opposite problems. The data necessary for their operationalization may be simply unavailable or unreliable, while their underlying assumptions about the structure of economic behavior and interaction in these countries may turn out to be utterly unrealistic.

Focus of the work

Monetary transmission investigates to the link between changes in the monetary environment and economic processes. In the context of the countries studied here it is important to broaden the view from purely monetary policy actions to overall changes in the monetary environment. This is due to the fact that three of the ten CEECs have a monetary regime dominated by currency board arrangements (CBA), where most of the traditional monetary policy tools are not at the disposal of the respective central banks. Thus in the CBA context it is difficult to speak of monetary policy actions, and yet it is still very important to study the transmission of monetary processes and changes to other economic processes. Also, due to the fact of transition and the ensuing constant institutional changes, the monetary environment is influenced in important ways by many actions which may not be directly attributed to the monetary authority. This observation is the basis of Garcia-Herrero's (1997) approach, where monetary transmission in investigated explicitly in the context of banking crises in several countries in transition, including the three Baltic states.

Having broadened the perspective, the area covered by the term "monetary transmission" becomes quite large. One way to organize this area is by splitting it into specific channels and steps of transmission. Very broadly, these channels include an interest rate channel, a credit channel, and an exchange rate channel (Mishkin, 1995) with many possible variations and intermediate cases. Two steps of transmission can be identified here: one related to transmission from the monetary environment to some intermediate variable such as lending and deposit rates, credit and monetary aggregates, the other one related to transmission from these intermediate variables to the ultimate macroeconomic variables such as aggregate demand and its components, unemployment, inflation, external balances, GDP. The characteristics of transmission over the two steps may be quite different, and this leads to the necessity to focus separately on the different steps. All the papers reviewed cover at least a subset of channels and steps, and most of the channels and steps of monetary transition have been studied in every country studied here.

Yet, recent practice (Bank of England 1999, European Central Bank 2000) suggests that from the point of view of knowing what happens in the economy and making decisions, the imposition of a framework of specific channels through which monetary policy works may be too restrictive. Ultimately, what is important is the information about links between monetary conditions and economic processes. Detailed specification of transmission channels may limit the analysis. This remark should be kept in mind when studying monetary processes in the transition countries. Regardless of the technique employed and the framework used, the results should be interpreted and inferences made with understanding of this limitation.

Short reviews of selected papers

Special attention to the credit channel of monetary transmission in Bulgaria is drawn in Nenovsky and Hristov (1998). The author makes use of various unstructured VAR specifications, using weekly data for 1997-1998. The results indicate that the variation in the government deposit as a quasi monetary policy instrument has an (negative, as expected from the setup of the Bulgarian currency board) effect on the money supply (M3), and also a significant effect on domestic credit and on the behavior of banks. Credit rationing is accepted as a hypothesis with respect to the lending to the private sector by Bulgarian banks. This is accepted as a confirmation for the existence of a credit transmission channel in Bulgaria. Nenovsky and Hristov (1999) then focus on the second step of transmission and study the link between the monetary and the real sector variables include different monetary aggregates, consumer prices, exchange rate, interest rates, and real variables (industrial sales index and retail sales index). The statistical techniques used include univariate analysis, correlation analysis, and unstructured VAR with impulse response and variance decomposition analysis. The authors find that the discretionary central bank regime (pre-1997) is associated with a strong negative relationship between monetary and real variables, which turns positive (albeit remaining small) under a currency board (post-1997). Under both regimes in Bulgaria money supply was not under the discretion of the central bank, but for different reasons (political influences under the discretionary central bank regime, and the lack of instruments for active monetary policy under a currency board).

Izak (1998) uses a VAR framework and examines the transmission through the lending channel between 1993 and 1997 in the Czech Republic. He shows that the very first step of the transmission from CNB repo rate to the money market was efficient and had a relatively small time lag. The next step between money market rates and bank rates on newly granted credits was also efficient, the two rates are cointegrated, and the error correction mechanism is somewhat slower than between central bank repo rate and interbank rates. The relationship between interest rates on newly granted credit and the volume of credits and investments had the expected negative sign, but these relationships proved to be statistically insignificant. Investment Granger causes credit volume with a time lag of 3 and 4 quarters, but not vice versa. Izak (1998) also estimated the second step of transmission by testing whether credit volume had an effect on industrial production and found that the two series are not cointegrated.

Pikkani (2001) uses a multi-equation structural model of the Estonian economy to study monetary transmission. In the case of Estonia discretionary policy is prevented by the currency board, so monetary shocks are represented by movements in the ECB official rate. Pikkani focuses on the interest rate and credit channels and on both steps of transmission. He finds that the shocks in the ECB rate do affect bank rates and lending, but the effects are weak in the long run. The evidence for the second step is similar – the ECB rate shock is transmitted to private consumption and investment, to output and its growth and to inflation and current account balance, but these links are also weak.

The various studies of monetary transmission in Hungary (Arvai (1998), Vilagi and Vincze (1998), Arvai and Menczel (2000)) seem to concentrate on the interest rate channel in its first and second steps. The general findings for Hungary are that the first step between market and bank rates does exist, but there is no strong evidence for the second step from bank rates to aggregate demand (savings and investment) or supply. One of the findings of Arvai (1998), however, is that while there is no relationship between market and bank rates before 1995, there is a link between market rates and short-run bank rates after that.

Babich (2001) and Vetlov (2001) use a narrative approach to study transmission in Latvia and Lithuania respectively, focusing on interest rate, credit and exchange rate channels and on both steps of transmission. They find that there exists a link between market rates and bank rates, especially to short-run rates. The credit channel is also identified, but it is relatively weak. With respect to the second step of transmission, the effect of bank rates and of total credit on final variables such as inflation or industrial production is found to be very weak or non-existent, while exchange rate is found to have some impact on inflation and GDP in the case of Lithuania (the link is difficult to interpret in the case of Latvia). Authors claim that the credibility of Lithuania's CBA has affected its effectiveness in bringing down inflation. Inasmuch as credibility can be considered a policy variable, it may also be important for monetary transmission.

Pelinescu and Scutaru (2000a and 2000b) study in a VAR-VEC framework the interest rate and credit channels and both steps of transmission. They find that until 1997 central bank rates affected bank rates, but later this effect was weakened due to liquidity constraints of commercial banks which points to the importance of the banking sector structure and condition in studying the transmission processes. On the second step, the interest rates seem to affect private spending, but do not affect the cost of capital and from there out-

put (due to the presence of weak budget constraints). Neithercredit nor money influence inflation and industrial production significantly, especially in the long run. A very interesting addition to this work is research done by Popa (1996) who finds in a cointegration framework an asymmetry of monetary transmission in Romania. Namely, interest rates do affect private firms' credit, but not state-owned ones. The relationship between interest rates and state-owned firms' demand for credits is even found to be positive, while the opposite is found for private firms. The same holds for the credit elasticity of output. The observation that monetary transmission may be asymmetric for private and state-owned firms may be relevant for all transition countries.

For Slovakia, Dovciak (1999) studies the interest rate and the exchange rate channels for both steps of transmission. He finds the evidence for the transmission from short-run to long-run rates to be conflicting, and attributes it to the lack of competition between banks and the absence of other credit sources besides banks – no capital market or non-bank financial institutions, low level of competition between banks, high fiscal deficits and crowding out effects. Dovciak also claims that high interest rates in Slovakia have not affected savings at the expense of consumption, and cannot confirm the existence of an exchange rate channel in either step of transmission. He explicitly suggests that recent progress in the reform process will probably strengthen and clarify the transmission mechanism in Slovakia.

Some general conclusions and suggestions

The review of the papers dealing with the monetary transmission mechanism in Central and Eastern Europe since the beginning of transmission suggests several conclusions. The first, and possibly most important, the papers reviewed do not hold much evidence of clear monetary transmission channels in the CEE. Most of the studies dealing with the first step of transmission, especially with the interest rate channel, do find some link between market interest rates (usually set or influenced by the central banks) and commercial banks' deposit and lending rates. However, even in the case of the first step of transmission, the link between changes in the central bank instruments or in the monetary environment variables (for the countries where no discretionary policy is present) and other intermediary variables such as the exchange rate, some credit or monetary aggregate, is rarely established.

Given the existing, but usually weak first step of transmission, the studies generally do not find the existence of a significant second step of transmission between the intermediate variables and the ultimate goals of monetary policy such as GDP and its growth, savings, investment, consumer spending, inflation, industrial production, while other ultimate goals like unemployment and wages are never considered.

Most of the authors explain the weak first step and the non-existent second step of transmission with institutional considerations. First, the banking sectors in the different countries are described as generally underdeveloped, financial intermediation is considered to be weak, the level of competition between banks – low, and the legal basis of financial activity, including the monetary policy setups – problematic and constantly changing.

Also most of the commentaries suggest that the authors believe that monetary policy transmission will improve with time. The argument is that with the process of integration with EU implying growing financial intermediation and institutional and structural reforms, the initial monetary policy signals will be much clearer, the reaction of the public – more settled and predictable, and the ultimate effect – stronger and observable.

3. Discussion on Monetary Policy Issues Related to Transmission Mechanism

Since the beginning of political and economic reforms in the ex-Soviet bloc in the early 1990s, the countries in transition have gone through a multitude of monetary regimes. By the end of 2000 the full spectrum of monetary policy setups, including different nominal anchors and balances between rules and discretion have been introduced across the region. This was done in the specific transition environment, along with building of market economy institutions, the creation of two-tier banking systems, gradual adoption of prudential standards and turbulent political processes.

The context in which the story of monetary policy during transition is submerged is very different from the context of the same story in developed market economies as well as in other emerging markets. The reason for this is the transition process and its characteristics. The level of dependence of the decisions of monetary authorities (whose establishment was itself one of the transition processes) on the decisions of other, sometimes seemingly quite distant players, cannot be ignored. Many institutions, organizations, procedures which are assumed to be given in other environments are not necessarily present in transition.

This fact justifies the need for a narrative about the conduct of monetary policy in transition countries, which may provide valuable insights into the usefulness and the limitations of the formal analysis of monetary transmission in this context. The present chapter provides such a narrative, summarizing a review of monetary policy regimes and events in the countries covered in the report, with a special attention to the pertinence of the story to the mechanism of monetary transmission.

Goals, targets and tools

At the initial transition stage all countries studied here have defined the domestic and external stability of their currencies as the main goals of monetary policy. In practice, domestic stability of a national currency relates to the levels and volatility of inflation, while the external stability has to do with the adopted exchange rate regime.

The stability of the value of domestic money is a monetary policy goal which is usually explicitly spelled out in the respective central bank laws. Whether it is termed "national currency stability" (Bulgaria, Estonia, Hungary, Romania, Slovenia), or "price stability" (Czech Republic, Latvia, Lithuania, Poland, Slovakia), this ultimate goal of monetary policy is made a responsibility of the monetary authority in every transition country reviewed here.

In some cases, the respective laws envisage one additional, and equal in importance, goal for the monetary authority – securing the working of the payment system, or ensuring liquidity, as is the case for the Bulgarian and the Slovenian national banks. In other cases (Czech Republic, Lithuania, Poland), legislators allow explicitly for a strictly secondary objective for the central banks, which is loosely defined as providing support for the overall economic policies of the government[1]. In all cases, this second objective is explicitly and strictly subordinated to the goal of price stability.Thus, given the fact that the maintenance of the payment system is more of a technical rather than policy issue, it may be concluded that the main goal for the central banks in all transition countries studied here and throughout the transition period, has been price stability.

While goals have been identical, the outcomes with respect to inflation have been widely divergent. Taking the 8 years from 1993 to 2000, some of the transition countries have managed to maintain an average annual rate of inflation[2] less than 10% (Czech Republic, Slovakia), while others have recorded average annual inflation rates of more than 70% (Romania, Bulgaria). If the 1993 GDP level is set at

[1] In the case of the Czech republic the relevant text even contains the requirement that the government policies to be supported are the ones leading to sustainable economic growth.

[2] Calculated as the geometric mean of the annual percentage increases in the CPI.

100, by the end of 2000 four countries (Hungary, Poland, Slovakia and Slovenia) have GDP indices of above 125, four countries (Czech Republic, Estonia, Latvia and Romania) have indices between 100 and 125, and two countries (Bulgaria and Lithuania) have indices below 100, again indicating a widely divergent performance.

If inflation and growth may be considered the dominant ultimate goals of monetary policy in the transition countries of Central and Eastern Europe, they were pursued with help of a variety of means. The general tendency in the use of monetary policy instruments was convergence towards the market-based instruments that are widely used in global practice. Initially, at least some of the CEECs used administrative instruments, such as credit ceilings and refinancing rationing – Bulgaria until 1993, Poland until 1992, Czechoslovakia until 1992 (where also interest rate ceilings were used). Later, all countries except for the ones with currency boards, adopted the three traditional tools of open market operations, discount rates, and reserve requirements. These were often accompanied by other instruments aimed at subtracting excess liquidity from the financial system (Polish National Bank bills, National Bank of Slovakia bills, Bank of Slovenia bills, Bank of Estonia certificates of deposit). In the currency board countries (Bulgaria, Estonia and Lithuania), all central banks retained the ability to use the reserve requirements, and a limited ability to influence the balances of commercial banks directly.[3]

With respect to operating targets, some central banks have "changed their minds" several times since the beginning of transition – Poland shifted from money market rate in 1993-1995 to reserve money in 1996-1997 back to money market rate after 1998, the Czech Republic moved from monetary base in 1992-1994, to bank reserves in 1994-1995, to money market rates in 1996-1997, to the more strictly defined 1 week PRIBOR since 1998. Other countries have stayed with one operating target throughout – a money market rate in Hungary, reserve money or the monetary base in Slovakia, Latvia and Bulgaria (before its currency board). It is possible that the countries which relied on the same operating targets throughout the period may exhibit a better link between instrument variables and operating target variables in formal analysis.

In terms of intermediate targets, some countries have also had been persistent, while others have changed the targets. Hungary, Estonia, Latvia, and Lithuania have been concerned with their exchange rates as the dominant nominal anchor throughout the period of transition.[4] Slovenia has also been persistent in its intermediate target throughout the period (M3 money supply target). In Bulgaria the exchange rate has always been a major target for the central bank. Prior to the currency board introduction, the exchange rate was targeted together with the money supply and the level of domestic credit. Romania has been concerned mostly with the level of general interest rates after 1996. Slovakia has moved from a predominant exchange rate target before 1998 to a money growth target after 1998. Possibly the most interesting cases are Poland and the Czech Republic, which after using exchange rate, broad money growth and interest rates (Poland) or the exchange rate (the Czech Republic) as targets, have adopted explicit inflation targeting, and use the more traditional intermediate targets mostly as indicators.

This brief description of the intermediate targets, following the enumeration of the various and often changing operative targets used by the Central and East European central banks, indicates that statistical, especially causal, links between the different variables may be expected to be weak. However, one valid observation is that all CEECs have found it extremely important to actively manage their exchange rates to achieve the ultimate goals.

Exchange rate regimes

Over more than ten years of transition and across the countries in the sample, the full range of exchange rate regimes have been introduced for shorter or longer periods. This claim is substantiated in table 1, which illustrates the historic developments in the exchange rate regimes of the 10 countries in the sample.

The columns of Table 1 contain the variety of exchange rate regimes ranging from highly institutionalized hard pegs, such as the Currency Board Arrangements (CBA), through looser fixed exchange rate regimes, different types of crawling pegs, to completely free floating currency. The crawling peg regimes are split into three groups according to the magnitude of the variation of the exchange rate allowed by the monetary authority before intervention – the wider this variation, the closer in practice is the respective regime to a free float.

[3] These include a "buffer" to be used for lending to commercial banks in case of systemic risk in Bulgaria, a limited lending facility of the Bank of Lithuania, and the already mentioned certificates of deposit issued by the Bank of Estonia, which were however discontinued in 2000.

[4] However, it may be inferred that the Hungarian National Bank was also paying attention to general interest rates, trying to stimulate domestic saving.

Table 1. Exchange rate regimes in transition countries, 1990-2001

Year	CBA	Fixed	Peg/band <2.5%	Peg/band 2.5-7.5%	Peg/band >7.5%	Managed float	Free float
1990		Poland, Hungary	Czechoslovakia				
1991		Hungary	Poland, Czechoslovakia				Bulgaria
1992	Estonia	Hungary	Czechoslovakia			Lithuania, Slovenia	Bulgaria, Latvia
1993	Estonia	Hungary	Czech Rep., Slovakia			Lithuania, Slovenia	Bulgaria, Latvia
1994	Estonia, Lithuania	Latvia, Hungary	Czech Rep., Slovakia			Bulgaria, Slovenia	
1995	Estonia, Lithuania	Latvia	Czech Rep., Slovakia, Hungary			Bulgaria, Slovenia	
1996	Estonia, Lithuania	Latvia	Czech Rep. Hungary	Poland, Slovakia		Bulgaria, Slovenia	
1997	Estonia, Lithuania, Bulgaria	Latvia	Hungary	Czech Rep., Poland, Slovakia		Romania*, Slovenia	
1998	Estonia, Lithuania, Bulgaria	Latvia	Hungary	Slovakia	Poland	Romania, Slovenia	Czech Rep.
1999	Estonia, Lithuania, Bulgaria	Latvia	Hungary		Poland	Romania, Slovakia, Slovenia	Czech Rep.
2000	Estonia, Lithuania, Bulgaria	Latvia	Hungary			Romania, Slovakia, Slovenia	Czech Rep., Poland
2001	Estonia, Lithuania, Bulgaria	Latvia			Hungary	Romania, Slovakia, Slovenia	Czech Rep., Poland

* Until the end of 1996 there was a heavy administering of the exchange rate in Romania, with 3 different exchange rates. As of the beginning of 1997 the regime is a managed float.

The first observation, which can be made after looking at table 1, is that there have been quite a few exchange rate regime changes, some of them quite dramatic, others – subtle. One consequence of the relatively frequent shifts in exchange rate regimes in most countries is that it makes the formal analysis of relationships between different variables more complicated and the inferences less precise.

The second inference that emerges from the table, is that with time countries tend to move towards the extremes, i.e. after shorter or longer periods of searching, by now most of the countries have either hard pegs or free floating regimes. This is very much in line with the global observation of this tendency made by Fischer (2000). Like many other countries, it seems that transition economies, too, learn in the course of time that the polar regimes (hard peg and free float) better suit the conduct of monetary policy. Consequently, they prove more sustainable and stable, and in the end they turn out better than the more discretionary "mixed" regimes that seemingly allow for better control, but are practically vulnerable and unstable.

Another important observation about the exchange rate regimes in the transition countries in the sample is that with the exception of Estonia[5] and Slovenia[6] all countries have made significant moves (in most cases more than one) within the space of exchange rate regimes[7]. In this respect there are two clearly differentiated groups, which generally move in opposite directions. The group of Poland, the Czech Republic, Slovakia and Hungary start the processes of eco-

[5] Estonia chose a currency board arrangement at the very beginning of introduction of its national currency and of creation of its financial system, and has not changed this regime since.

[6] Slovenia, after a very brief period of free floating necessitated by high exchange rate volatility and lack of reserves after emerging from ex-Yugoslavia, chose a managed float and has maintained this regime since then.

[7] Romania also has experienced a regime change, but it moved from direct administration of the exchange rate for firms until the end of 1996 (a regime which is difficult to place in the space of Table 1) to a managed float in the beginning of 1997.

nomic reforms with more or less hard pegs and by 2001 have moved to free or near-free floating. The opposite movement is observed for Bulgaria, Lithuania and Latvia. Beginning reforms with regimes close to free floating, these countries have found it necessary to introduce[8] hard and formalized pegs. This "stylized fact" is, of course, subject to change with time, but the change cannot be expected to be too dramatic. All of the countries discussed here are applying for membership in the European Union, and will have the obligation to converge to the ERM II regime in the foreseeable future, so the further dynamic of the respective exchange rate regimes is highly predictable.[9]

It is difficult, however, to generalize the reasons for the changes in exchange rate regimes in the transition countries – each country has a unique set of circumstances and policy decisions. One speculative explanation of the stylized fact can be that countries where the dynamics of the nominal exchange rate[10] has become a political problem, have opted for hard peg regimes, while countries where the nominal exchange rate has been less erratic and has constituted less of a political issue, have gradually moved towards a regime of free floating.

Exchange rate regimes are important for the transmission of monetary changes in transition countries in several ways. Arguably the most important way is through the relevance of the exchange rate regime, of its credibility for the economic agents, and of the actual behavior of the nominal exchange rate for the level of currency substitution. The higher the level of currency substitution in a country, the less effective the traditional set of monetary policy tools at the disposal of the respective central bank. Actions of the monetary authority pertaining to money market interest rates, reserve requirements, and refinancing may turn out to have a negligible effect on, say, inflation and output in comparison with actions of the monetary authority aiming at influencing the behavior of agents with respect to the currency structure of their assets.

Another way in which the exchange rate regime, its credibility and effectiveness are relevant for the output and price processes in transition economies is through its relevance, together with the level of structural reforms, with the degree of fiscal discipline, and with the quality of the overall investment climate, for the inflow of foreign investments. This theme will be taken up in the next section.

The importance of the transition context

The monetary policy transmission mechanism is strongly influenced by many factors beyond the monetary policy tools. Such influence is, of course, typical for the context of monetary policy everywhere, but it may be very specific during transition. The politics of transition, the extent and quality of structural reforms, including the role of the central bank, the different developments in the financial sector are important elements of the monetary policy context in transition.

As mentioned previously, politics may be an important element of the monetary landscape during transition. Transition involves a fundamental transformation not only of the economic system, but of the political system as well. Since every transition country has gone through the initial transition recession characterized by a severe loss of living standards, decisions about economic policy have been highly dependent on the resolution of political and social issues. At the same time, institutions and organizations necessary for the conduct of monetary policy were only being established at the beginning of transition. At least initially they did not have the institutional and political capacity to oppose and defeat decisions of other actors in the field of economic policy.

A brief look at monetary policy developments in the countries studied here offers support for this point. The fiscal stance of the respective governments, which reflects the outcome of a complex political process, has been important for the monetary environment. This is by definition true for the currency board countries, where monetary policy boils down to a simple and strict rule with negligible possibilities for discretion and as a result the sustainability of the whole regime depends on the behavior of the fiscal policy.

A good example is provided by the policy actions aimed at cushioning the effects of the Russian crisis of 1998 undertaken in the three Baltic countries, all of which have a regime of currency board or hard peg. The reaction to the crisis was most substantive in the budgetary sphere. The increases in the budget deficits were the major response to the difficulties presented by the crisis to these countries, and the rest of the burden was borne by the real economy. Consequently, all three Baltic countries suffered GDP contraction, interest rates increases, stagnation in prices and money supply in the three quarters following the crisis.

[8] In all three cases this was done through a discrete jump over the full spectrum of exchange rate regimes.

[9] Of course, the issue whether the currency board arrangements will be recognized as satisfying the ERM II requirements still remains unclear.

[10] Usually closely related to the dynamics of the domestic price level.

In countries where monetary policy has enjoyed more formal independence, such as Poland, the Czech Republic, Slovakia, Romania, Bulgaria (before 1997), the fiscal developments have become main factors influencing the financial markets and major determinant of the overall investment climate and confidence in the economy. This relevance has taken a variety of forms. In Romania and Bulgaria one of the major channels were large arrears of state owned enterprises to the banking sector which influenced their behavior and also led to eventual monetization of quasi-fiscal deficits. In the Czech Republic in the first half of the 1990s the adopted privatization method through vouchers led to accumulation of bad loans, while at the same time fiscally determined wage increases and government investment projects led to an expansion of demand while supply was unrestructured and insufficient, thus leading to increases in inflationary pressure. For Slovakia, persistently high budget deficits are considered one of the factors weakening the link between monetary impulses and medium term interest rates, and are commonly made responsible for the 1997 currency attack (Dovciak, 1999). In Poland, the beginning of the 1990s saw the issuance of treasury bills by the government as the most potent instrument for absorbing excess liquidity. One of the reasons for the relatively slow drop of inflation and the corresponding lower level of confidence in the currency board regime in Lithuania were the administratively set increases in regulated prices.

In an environment of underdeveloped financial intermediation (see below) and overall crisis of the real sector, which corresponds to the initial period of transition, the state finds itself as the only credible issuer of securities. Given its social needs at that moment, it usually utilizes this position heavily, with two adverse effects. First, large resources are crowded out from the fledgling private sector. Second, the development of financial intermediation is impeded. As a result, the behavior of the fiscal policy in the countries mentioned above, was the major determinant of price dynamics (when the deficits were monetized in one fashion or another), of interest rates, and of financial flows for long and important periods. In at least one extreme case (Bulgaria) the ease of borrowing, among other things, helped to create a disincentive for the government to undertake painful structural measures, encouraged it to accumulate large deficits, and severely hindered the development of the private sector.

The degree of commitment of the transition governments to implementing structural reforms and the resulting quality and speed of these reforms is an important determinant of the environment of monetary policy and thus of the link between policy actions and macroeconomic variables. From the point of view of monetary policy and its transmission, structural reforms define many of the constraints faced by firms and households, and thus to a large extent shape their behavior in different circumstances, including their response to monetary policy actions.

For example, structural reforms to a large extent consist, among other things, of fundamental transformations in property rights, and especially in property rights enforcement mechanisms. This includes changes in formal and informal institutions and hence in incentives faced by economic agents. The way in which property rights are defined and enforced in a transition country to a large extent determines the relative sizes of groups of agents that engage in productive or redistributive entrepreneurship, as well as the actual relative rate of return to illegal or "gray" activities. Another important link between the quality of definition and enforcement of property rights and real economic activity is through the time horizon of decisions made by economic agents. Poor property rights definition and enforcement result in shorter time horizons due to increased uncertainty about outcomes and severely dampens the ability of the financial system to perform its basic functions. Therefore, the decisions of economic agents as to the type of economic activity to engage in and appropriate time horizons to choose, determine on the macro level investment behavior, overall GDP potential and dynamics, the money multiplier, the effectiveness and efficiency of financial intermediaries.

An important element of structural reforms affecting the monetary policy directly is the degree of formal and informal independence of the newly created central banks and the definition of their responsibilities. The institutional strength of a central bank is important for monetary transmission, because the weaker the monetary authority, the less able it is to implement independent policy decisions. Provided that central banks in transition were just being created from scratch as independent policymakers and were correspondingly inexperienced and incoherent, the opportunities for other actors to influence their decisions were ample, and the problem was especially pronounced.

These 'other' actors were predominantly politicians and commercial bankers. Through their relative institutional strength they were able to impose on central banks, with various degree of success, monetization of budget deficits and refinancing of dubious credit expositions. In the beginning of transition the central banks were more or less inad-

equate in their regulatory functions and were not capable of strictly imposing prudential regulation standards on commercial banks, which also made them intervene periodically by injecting liquidity to avert crises.

The decisions of central banks influenced by other institutional actors were often in conflict with other decisions, related to the use of more traditional monetary instruments and aimed at the usual goals of price stability, employment, and real growth. This led to inconsistent behavior of the monetary authorities in transition countries on many occasions, only some examples of which are presented below.

The fixed exchange rate regime announced by the Hungarian National Bank between 1990 and 1995 was in conflict with other goals and actions of both the fiscal and the monetary authorities, and as a result the currency was devalued no less than 23 times in these 5 years. Whatever interests or goals were pursued through these actions, they did not serve the credibility of the fixed exchange rate regime. In 1992 the Bank of Latvia was trying to curb inflation through relatively high interest rates, but was also giving out direct loans to the government, providing an inflationary impulse. After having allowed for the accumulation of direct government debt to the central bank in 1993-1994, the Bank of Latvia found itself dependent on this position. When it was trying to foster economic growth by dropping interest rates, it could not stop the government from returning the old debt, which was in practice a sterilization of the expansionary policy. In 1995-1996 the National Bank of Slovakia was trying to limit money growth by a mix of increased reserve requirements and refinancing tightening, but at the same time was sterilizing foreign capital inflows deemed to be too large, and was thus increasing the growth of M2. In December 1996, after having raised the base interest rate to record high levels in an attempt to curb inflation and currency depreciation, the Bulgarian National Bank agreed to issue financial aid (of more than 6% of the Bulgarian GDP) to cover the budget deficits, which set the stage for hyperinflation and steep depreciation. The monetization of fiscal and quasi-fiscal deficits, and the inability to prevent banks from near-crisis situations, have contradicted the disinflation policies of the Bank of Romania.

Interestingly, on several occasions the inconsistencies in the signals sent by the central banks were due to their own relative success. In Latvia, Lithuania and Slovenia during the early stages of transition as well as Poland in 1997-1998, the central banks managed to credibly commit themselves to lowering inflation. But the very credibility of this commitment led to increased external confidence in the respective economies and to inflows of foreign currencies. These inflows resulted in significant increases in the money supply thus contributing to slowing down of the disinflationary process to which the central banks had committed in the first place. Central banks in these countries responded differently. The Bank of Poland started accepting deposits from the public (to lower money supply), The Bank of Latvia used interest rates, the Bank of Lithuania used reserve requirements, and the Bank of Slovenia used administrative controls over the foreign exchange inflows. In all cases the need to use these instruments contradicted other signals the central banks wanted to send, especially with respect to the goal of increasing output in the wake of the initial transition recession.

This inconsistent behavior of central banks in transition, especially in its early stages, naturally means a decreased effectiveness of the traditional monetary policy tools. In formal studies this may mean a lack of distinct links between tools, operating targets, intermediate targets, and ultimate goals of monetary policy. Therefore a study of the level of the institutional capacity and of the actual independence of central banks in transition countries may be quite relevant for the understanding of their monetary transmission mechanisms.

Despite the importance of the central bank in this mechanism, commercial banks are possibly the crucial players, and their operation is a major determinant of the causal relationships in the monetary environment. The development of banks during transition has its specific characteristics. First, most of the transition countries had to establish the traditional two-tier banking systems in parallel with the initial stages of other structural reforms. Second, in the initial stages of transition the banking systems in all transition countries were dominated by the state through both ownership of banks and administrative instruments. So banks had to restructure and learn together with the rest of the economy.

Almost everywhere in the region the number of banks quickly increased after liberalization of the banking sector. Most of the new banks were poorly equipped with capital, inexperienced, and non-competitive. At the same time, they had to compete for attracting business in the conditions of excess liquidity inherited from socialist times, coupled with dramatically falling real economic activity due to the early-transition recession. Most of the times they had to act in the environment of soft budget constraints as well. All this meant aggravated adverse selection and moral hazard problems both between banks and their clients and among bankers themselves.

In most transition countries the banking systems were not capable of overcoming these problems without crises – outright banking crises in Estonia (1992), Latvia (1995), Lithuania (1995-1996), Bulgaria (1996-1997), severe bad loan problems in the Czech Republic (an important factor in the currency crisis of 1997), Slovakia and Romania. All these problems can be traced back to lending and borrowing practices that were unrestrained, expansionary and often fraudulent. For most of these countries, the banking systems operated in near-crisis environment for relatively long periods of time. Under these conditions, both the bankers and the depositors were facing specific constraints, and were engaged in solving distinct problems. The resulting behavior decreased furthermore the effectiveness of whatever remained as coherent signals left after the inconsistencies of the central bank actions.

Some general conclusions

The narrative about monetary policy in CEE since the beginning of transition presented in this chapter is aimed at showing that for much of the decade of reforms the environment in which monetary policy was conducted was far from approximating "neoclassical" conditions. With respect to the formal analysis of monetary transmission in these countries during this period, at least two important observations need to be emphasized.

The first one is that some specific constraints and behavioral incentives in the transition context may render traditional policy tools less effective than a neoclassical environment would suggest. During transition, the institutions which are important for the effectiveness of monetary policy are underdeveloped by definition, while processes hampering monetary transmission (budget deficits, bad loans, various predatory projects) may be very strong or even dominant at times. This environment may even force the monetary authority itself into inconsistent actions, decreasing their effectiveness even further.

The second observation is that the transition is a very dynamic phenomenon, which was subject to constant qualitative change in all countries reviewed here since the early 1990s. Structural change was observed throughout the period and thus the underlying environment of the data was changing and was not homogeneous for the period. It may be claimed that towards the end of the observed period the monetary environment was much closer to Western standard conditions than in the beginning. Thus all countries have experienced at least one structural break, with later periods more favorable for formal analysis than earlier ones.

4. Data Selection and Description

Following the narrative part that was meant to shed some light on the related literature (chapter 2) and the importance of the transition context (chapter 3) we now proceed to the empirical part of the paper. In this chapter we describe the variables used in subsequent analysis with the special emphasis on the measure of inflation. The following chapter presents empirical analysis.

4.1. Core Inflation Estimates and Selection

Inflation behavior is central to analysis of transmission mechanism. Consequently, the choice of inflation indicator is very important to subsequent research. Most studies on related subjects use the conventional measure of inflation, i.e. the consumer price index (CPI). However, using the CPI as a proxy for general price movements in transition economies might prove misleading. Radical relative price shifts that have taken place throughout the decade of the 1990s have caused serious distortions in the price structure. It is a well documented fact[11] that prices of some goods and services (such as pharmaceuticals, fuels, electricity and municipal services) have undergone a pronounced upward adjustment. The CPI assigns each price movement the weight proportional solely to its share in total household expenditures and is therefore, by construction, very sensitive to the presence of outlier price jumps. Consequently, extreme price increases, mostly of administrative nature, were producing substantial upward bias in the index. In addition to producing a bias, administrative (and agricultural) price changes were also introducing a great deal of short-term noise to the index. Most transition countries have also developed a deep-rooted price change seasonality (both of administrative and weather-based nature) that often rendered CPI movements erratic.

For these reasons we felt that CPI-based inflation will not serve our purpose very well and instead we decided to make use of core inflation. However, core inflation is not a clearly defined concept in theory and therefore renders itself to various practical interpretations. In general all statistical techniques proposed in the literature rely on the notion that measuring core inflation is in fact a statistical problem of estimating trend price movements. Therefore methods used currently across central banks are constructed to best gauge fundamental price changes in the economy and abstract from short-run and reversible relative price shifts. These methods include: permanent exclusion of broad CPI aggregates such as food or energy (in most countries), trimmed means (for example in UK and Poland) or variance-weighted means (Canada).

Core inflation estimates

We decided to devote a separate section to core inflation for a number of reasons. First, official core inflation estimates are not available for all transition economies, so we had to compute our own series. Secondly, most countries that calculate core inflation do so, using different techniques and methods. Finally, for a couple of countries we found "competing estimates" calculated by different institutions (Hungarian central bank and statistical office) or the same institution (Poland's central bank).

We could not find official core inflation series[12] for the following countries: Bulgaria, Romania, Slovenia, Lithuania, Latvia and Estonia. For some countries that publish core inflation, initial sample years were missing, so extending the

[11] See for example Pujol and Griffiths, 1996 and Woźniak, 1998.

[12] Neither central banks nor statistical agencies did not publish official estimates on their websites and in most important periodic publications (such as monthly bulletins).

series back to 1995 was necessary. Using the methodology provided by the central banks we calculated the respective series for Poland for 1995-97 and for Slovakia for 1995-1996. Czech and Hungarian series were the only series that covered the entire sample period, i.e. 1995-2000.

For the countries for which we had no estimates, we calculated two conventional, most frequently used core indices:

- Core inflation index with prices of food and energy excluded,
- Core inflation index with administratively controlled prices excluded.

Calculation of the second index required some additional research to determine the extent of the controlled sector in each country. Goods and services most commonly eliminated included electricity, gas, fuels, pharmaceuticals, rents, central heating and hot water supply.

Thus, our core inflation database contained 2 or 3 core inflation series for each country. In order to determine which one should be included in the subsequent calculations we used a set of criteria recently put forth in the literature.

Series selection

Our main selection criterion was based on a set of 3 necessary conditions of a good core inflation indicator: unbiasedness, "attraction" and exogenity. This criterion was first proposed by Freeman (1998) and then augmented by a group of economists from the Central Bank of Portugal[13]. These criteria refer to 3 properties that any good core inflation estimate should posses if it is to be helpful for monetary authorities:

- Core inflation series should be unbiased with respect to the CPI.
- CPI should fluctuate around core inflation, i.e. core inflation should "attract" the CPI.
- Core inflation should be (strongly) exogenous with respect to the CPI.

These properties have been formalized in a set of 3 criteria (see for example Marques, P. D. Neves and da Silva, 2000). In the notation below π^c refers to core inflation and π to CPI inflation:

Criterion 1) Unbiasedness

π^c is I(1) and π^c and π are cointegrated with unitary coefficient, i.e. $(\pi^c - \pi)$ is stationary with zero mean

Criterion 2) "Attraction"

There is an error correction mechanism for π given by $(\pi^c_{t-1} - \pi_{t-1})$, i.e. $\gamma \neq 0$ in the equation:

$$\Delta\pi_t = \sum_{j=1}^{n} \alpha_j \Delta\pi_{t-j} + \sum_{j=1}^{m} \beta_j \Delta\pi^c_{t-j} + \gamma(\pi_{t-1} - \pi^c_{t-1}) + \varepsilon_t$$

Criterion 3) Exogeneity

π^c should be weakly (strongly) exogenous with respect to π, i.e. λ (as well as all thetas -θ_j) should be equal to zero in the following equation:

$$\Delta\pi^c_t = \sum_{j=1}^{r} \delta_j \Delta\pi^c_{t-j} + \sum_{j=1}^{s} \theta_j \Delta\pi_{t-j} + \lambda(\pi^c_{t-1} - \pi_{t-1}) + \eta_t$$

Our evaluation and selection procedure involves checking the above criteria for 2 or 3 available core inflation series for each country. If out of the 2 or 3 series, only 1 fulfills all the criteria, this series is chosen to be the superior core inflation estimate and will be used in subsequent analysis. If however, either more than one series fulfills the criteria or none of the series fulfills them, we proceed to the next selection step. This step makes use of the earlier criterion formalized by Cecchetti (1996) and applied most extensively in the core inflation literature. The criterion refers to **minimizing deviations from trend inflation**. Cecchetti points out that what central bankers are looking for in monthly inflation figures are timely estimates of a long-term trend in general price level. Therefore, core inflation series that tracks this trend closely should also be considered a good inflation measure for monetary policymakers.

Two assumptions are crucial in order to evaluate core inflation series using this criterion. First, one needs to define the trend series and the function to be minimized. In our calculations we used a 24-month moving average of the CPI inflation as a proxy for the trend and a root mean square error (RMSE) as a deviation function:

Root mean squared error $RMSE = (N^{-1} \Sigma d_i^2)^{0.5}$

where d is the deviation of core inflation from the 24-month centered moving average of CPI inflation and N is the number of observations.[14]

The selection procedure we adopted can be summarized as follows:

Step 1) Check the unbiasedness, attraction and exogenity criteria for all series available for each of the 10 countries.

[13] See for example Marques, Neves and da Silva (2000) and Marques, Neves and Sarmento (2000).

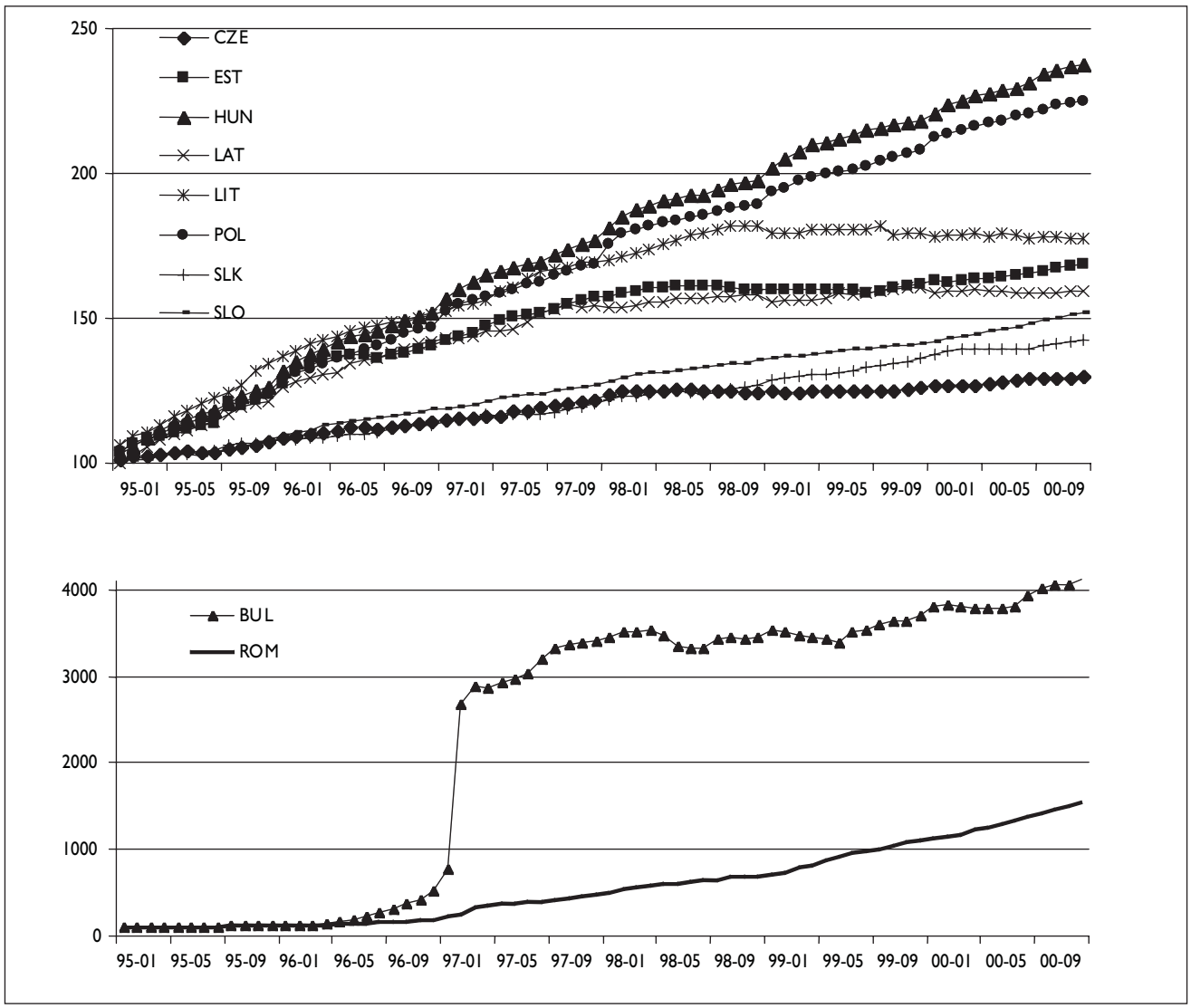
[14] Although we do check robustness of our results using other trend moving averages.

Table 2. Selected core inflation indicators

Country	Selected core inflation series
Poland	CPI excl. food and fuels ('net inflation')*
Hungary	CPI excl. seasonal foods, fuels and pharmaceuticals ('central statistical office core inflation')
Czech Republic	CPI – administratively controlled items ('net inflation')
Slovenia	CPI excl. food and energy
Slovakia	CPI excl. administratively controlled items ('core inflation')
Romania	CPI excl. unprocessed foods and administrative prices
Lithuania	CPI excl. food and energy
Latvia	CPI excl. food and energy
Estonia	CPI excl. administratively controlled items
Bulgaria	CPI excl. administratively controlled items

* Names in parentheses refer to official names of core series as given by the institution calculating it in a respective country.

Figure 1. Core inflation index (Jan 1995=100)



BUL- Bulgaria, CZE-Czech Republic, EST-Estonia, HUN-Hungary, LAT-Latvia, LIT-Lithuania, POL-Poland, ROM-Romania, SLK-Slovakia, SLO-Slovenia.

Source: Respective central bank's websites and authors' calculations.

If the results point to one particular series, this series will be used as a core inflation estimate for the respective country.

Step 2) If step 1) yields inconclusive results, select the series based on minimizing its deviation from the trend (24-month moving average of the CPI). Choose the series with the smallest root mean squared error of the deviation.

In table 2 we present results[15] of our selection, i.e. series that were chosen based on the selection process described above for each country. All 10 core inflation series are depicted in figure 1 as indices set at 100 in January 1995.

4.2. Data Presentation

Most data series used in subsequent analysis come from the International Monetary Fund's International Financial Statistics Database[16]. Alternatively, if the data were not available in the IFS the following databases and sources were used: Information Notice System Database, OECD Main Economic Indicators Database, respective IMF Country Desk Databases, respective statistical offices and central bank publications. All data series are in monthly frequency and cover the period January 1995 – December 2000. Thus there are 72 monthly observations.

Exchange rate used is the average local currency against the Euro, interest rates are most important local short-term money market rates (usually 1- or 3-month interbank rate) and industrial production has the conventional definition. Core inflation selection was explained in the preceding section.

Table 3 presents developments in four variables that we intend to use in the first stage of monetary transmission analysis for selected countries. A number of conclusions can be drawn from this table. There are two countries that experienced hyperinflation in the period between 1995-2000: Bulgaria and Romania. As the table makes clear these episodes proved very detrimental to growth and both countries made no progress in terms of industrial output. Output actually fell in Bulgaria (which had a more severe inflation outburst) and it rose as little as 2% in Romania. Hungary and Poland are on the other side of the growth experience. Hungary more than doubled its industrial output within six years, while Poland's output grew by almost 60%. Remaining countries managed to boost their output by around 10-20% within six years. All countries had lower interest rates in December 2000 than in January 1995, which reflects lower inflation (more precisely a twelfth difference of analyzed core inflation index). The biggest decline took place in Bulgaria and Latvia, thanks to currency board arrangements.

It turns out that high-growth countries were also the ones with relatively high inflation. Hungarian and Polish price levels more than doubled within the sample years. During this period Hungary has been conducting a more accommodative monetary policy, its exchange rate depreciated against Euro some 93 index points and interest rates fell by some 14 percentage points. In the same period Polish zloty depreciated only 25% against Euro and interest rates fell 11 percentage points.

The correlation between price level and exchange rate changes is evident – high inflation countries tend to have sizeable exchange rate depreciations. This fact is widely recognized in economic literature and there is considerable

Table 3. Data summary (Jan-1995 – Dec-2000)

Country	Core inflation	Growth	Interest rate	Exchange rate
Bulgaria	3366.5	-10.9	-73.3	2264.7
Czech Republic	28.3	16.3	-5.9	3.0
Estonia	58.2	24.0	-12.7	-3.2
Hungary	134.7	109.7	-14	93.0
Latvia	56.2	9.49	-21.7	-15.4
Lithuania	71	49.9	-22	-25
Poland	112.8	58.8	-11.7	25.1
Romania	1423	1.89	-5.30	992.2
Slovakia	40.9	30.6	-2.43	12.5
Slovenia	57.4	10.3	-13	37.4

Note: Table presents the difference between December 2000 and January 1995 - end points of our data sample. Inflation, growth, interest and exchange rate are expressed as a change in the index; interest rate is in percentage points; exchange rate indicates change in nominal value, higher values reflect nominal depreciation.

[15] Details of the testing procedure and results are available from the authors.

[16] We would like to thank respective country departments at the IMF for helping us assembling the data.

evidence suggesting that exchange rate channel was very important in shaping inflation processes in CEE countries (for instance see Rybinski 2000). All three Baltic countries saw their currencies appreciating in nominal terms against the Euro in the analyzed six-year period. This has put strong pressure on the real economy and has also been reflected in a sharp increase in external imbalances.

4.3. Testing for Level of Integration

The natural start of any multi-variable empirical analysis is testing for the level of cointegration. We used conventional ADF tests which were computed using maximum lag order of six[17]. Limited sample size suggests that parsimonious models should be preferred. Therefore, out of the 3 generally used information criteria (AIC, SBC and HQC) the Schwarz Bayesian Criterion (SBC) was selected because it involves bigger punishment for adding regressors to the model. The critical value for ADF test with intercept at 95% confidence level is – 2.90. The analogous value for ADF test with intercept and linear trend is – 3.48.

One has to keep in mind that the power of ADF-type tests for the order of integration is very low, especially when structural breaks are present[18]. As chapter 3 made clear structural breaks constitute an imminent characteristic of time series in CEE economies, hence results reported below should be taken with some caution. Later we resort to other cointegration-based testing procedures, which could lead to more robust conclusions, hence we do not investigate this issue further.

ADF test results for industrial production seem fairly consistent across the sample. With the exception of Latvia, Lithuania and Slovakia all indices are I(1) around constant and I(1) around linear trend. This is also a plausible hypothesis in our later attempt to pin down the long run relationships. If proper policy mixes are pursued in CEE countries, industrial output should expand to allow for catching up in the level on incomes per capita. This is a truly long-run process, expected to take 20 to 50 years.

ADF test results for exchange rates series are somewhat surprising. Given wide range of pursued exchange rate regimes (see table 1) one should expect different statistical properties of the series. Bulgaria has moved to a currency board arrangement in he middle of the sample period, Estonia and Lithuania adopted currency boards earlier. Poland has followed crawling band regime with frequent interventions and then widened the band to float the zloty in May 2000. Hungary has conducted crawling band regime (with a much tighter band) throughout the sample and decided to float the forint only in June 2001. Nevertheless, despite

Table 4. Industrial output: ADF test results

Tested variable	Industrial output					
	Level/lag	First difference /lag	Order of integration	Level/lag	First difference /lag	Order of integration
version of the test	ADF test with intercept			ADF test with intercept and linear trend		
Bulgaria	-1.73 / 2	-10.6* / 1	1	-2.11 / 2	-10.6* / 1	1
Czech Republic	-2.64 / 4	-10.19* / 3	1	-3.14 / 4	-10.12* / 3	1
Estonia	-1.44 / 0	-7.55* / 0	1	-1.51 / 0	-7.55* / 0 #	1
Hungary	0.21 / 2	-11.93* / 1	1	-2.57 / 2	-11.97* / 1	1
Latvia	-4.08* / 0	-8.21* / 0	0	-3.97* / 0	-8.16* / 0	0
Lithuania	-4.72* / 0	-8.36* / 1	0	-4.73* / 0	-8.29* / 1	0
Poland	-1.53 / 5	-8.16* / 4	1	-2.21 / 5	-8.22* / 4	1
Romania	-1.86 / 0	-8.03* / 1	1	-2.89 / 0	-7.98* / 1	1
Slovakia	-0.2 / 2	-9.12* / 1	1	-3.53* / 1	-9.13* / 1	0
Slovenia	-0.17 / 0	-7.12* / 0	1	-2.57 / 0	-7.13* / 0	1

AIC suggests lag two and then I(1) hypothesis is marginally rejected at 5% level and variable is I(2)
95% significance level is denoted by *
Source: Authors' calculations.

[17] Variables: industrial output, core inflation and exchange rate are expressed as logs of indices with base period January 1995=100. Interest rates are expressed as (1 + interest rate / 100).

[18] See for example Bai and Perron (1995) and Rybiński (1997).

these differences all exchange rate series are I(1). This outcome may very well be the consequence of problems suggested by Perron (1989) and Rybiński (1997), i.e. the low power of ADF test in the presence of structural breaks. This argument is of special validity for the economies under investigation – since most of them experienced many regime shifts and high inflation episodes.

To complicate the situation even further we note that ADF testing procedure suggests that most core inflation indices in the CEE are I(0). With the exception of Bulgaria, Romania and Slovenia, core inflation (measured as an index) appears to be a stationary process. A quick look at the series (see figure 1) proves that these variables are trended, so we should use ADF test with linear trend. In the second specification only Estonia and possibly Latvia appear to have core inflation stationary around linear trend. These results are much more encouraging, as one should expect that countries with non-stationary exchange rates with a relatively strong pass-through from exchange rate to inflation would also have non-stationary inflation series. Here we may encounter some problems with the long run, as one should expect that within next few years these countries will all lower their inflation rates (twelfth difference of the

Table 5. Exchange rate: ADF test results

Tested variable	**Exchange rate**					
	Level/lag	**First difference /lag**	**Order of integration**	**Level/lag**	**First difference /lag**	**Order of integration**
version of the test	ADF test with intercept			ADF test with intercept and linear trend		
Bulgaria	-2.06 / 1	-4.78* / 0	1	-1.22 / 1	-5.17* / 0	1
Czech Republic	-2.64 / 0	-10.56* / 0	1	-2.82 / 0	-10.49* / 0	1
Estonia	-2.03 / 0	-6.87* / 1	1	-1.00 / 0	-7.12* / 1	1
Hungary	-2.31 / 0	-7.42* / 0	1	-0.99 / 0	-7.95* / 0	1
Latvia	-0.57 / 0	-6.72* / 0	1	-2.08 / 0	-6.67* / 0	1
Lithuania	-1.04 / 0	-6.98* / 0	1	-2.39 / 0	-6.92* / 0	1
Poland	-1.76 / 1	-5.76* / 0	1	-0.78 / 1	-6.10* / 0	1
Romania	-1.02 / 1	-5.59 * / 0	1	-2.54 / 1	-5.63* / 0	1
Slovakia	0.14 / 0	-6.23* / 0	1	-1.77 / 0	-6.37* / 0	1
Slovenia	-2.08 / 1	-10.33* / 0	1	-3.48* / 0 #	-10.43* / 0	1

ADF test for Slovenia showed 95% significance based on SBC criterion, however AIC criterion suggested that variable is I(1)
95% significance level is denoted by *
Source: Authors' calculations.

Table 6. Core inflation: ADF test results

Tested variable	**Core inflation**					
	Level/lag	**First difference /lag**	**Order of integration**	**Level/lag**	**First difference /lag**	**Order of integration**
version of the test	ADF test with intercept			ADF test with intercept and linear trend		
Bulgaria	-1.90 / 1	-5.23* / 0	1	-1.12 / 1	-5.53* / 0	1
Czech Republic	-3.22* / 1	-5.28* / 0	0	-1.90 / 1	-6.26* / 0	1
Estonia	-3.83* / 1	-2.58 / 0	0	-4.15* / 1	-4.42* / 3	0
Hungary	-3.59* / 1	-4.12* / 0	0	-1.80 / 0	-5.57* / 0	1
Latvia	-6.39* / 6	-4.87* / 0 #	0	-4.60* / 6 ##	-6.57* / 0	0 / 1
Poland	-4.10* / 0	-6.26* / 0	0	-1.39 / 0	-7.56* / 0	1
Romania	-1.08 / 1	-3.88* / 0	1	-1.67 / 1	-3.98* / 0	1
Slovenia	-2.40 / 0	-5.86* / 0	1	-2.95 / 0	-6.08* / 0	1
Lithuania	-8.49* / 0	-1.73 / 2	0	-2.16 / 0	-6.71* / 0	1
Slovakia	-0.87 / 1	-5.60* / 0	1	-5.13* / 4	-5.62* / 0	0

AIC criterion selects lag order six, for which ADF test rejects I(1) hypothesis and accepts I(2)
all lags smaller than do not reject I(1) hypothesis, but all criteria select lag six
95% significance level is denoted by *
Source: Authors' calculations.

Table 7. Interest rate: ADF test results

Tested variable	Interest rate					
	Level/lag	First difference /lag	Order of integration	Level/lag	First difference /lag	Order of integration
version of the test	ADF test with intercept			ADF test with intercept and linear trend		
Bulgaria	-1.42 / 0	-6.47* / 0	I	-3.84* / 5 ##	-6.42* / 0	0 / I
Czech Republic	-0.35 / 0	-8.52* / 0	I	-1.82 / 0	-8.55* / 0	I
Estonia	-3.07* / 0 #	-10.50* / 0	0 / I	-3.74* / 0 ###	-10.42* / 0	0 / I
Hungary	-0.29 / 0	-8.59* / 0	I	-2.55 / 0	-8.51* / 0	I
Latvia	-2.58 / 0	-9.43* / 0	I	-2.27 / 0	-9.72* / 0	I
Poland	-1.95 / I	-4.67* / 0	I	-2.14 / I ####	-4.63* / 0	0 / I
Romania	-4.50* / I	-5.60* / 0	0	-4.45* / I	-5.57* / 0	0
Slovenia	-2.33 / 0	-8.60* / 0	I	-3.10 / 0	-8.54* / 0	I
Lithuania	-2.88 / 0	-9.62* / 0	I	-3.09 / 0	-9.87* / 0	I
Slovakia	-1.17 / I	-6.50* / I	I	-0.86 / I	-10.97* / 0	I

AIC selects lag order one, and then variable is I(1)
I(1) for all lag orders except five, however five was selected also by AIC and HQC criteria
for all lags higher than zero variable is I(1). However all criteria select lag 0, AIC marginally prefers lag zero to lag one
AIC selects lag six for which ADF rejects I(1) and accepts I(0)
95% significance level is denoted by *
Source: Authors' calculations.

index) to levels common in the Euro area. This belief is based on the fact that all considered countries applied for the EU membership and once admitted to the Union will aim to become members of the Euro-zone. Considering this as a very likely scenario for near future, any estimate of the long run (based on the data in the sample) will tend to overstate the prospective pace of inflation.

Interest rate testing results are consistent with intuition. If exchange rate and inflation are non-stationary, interest rates should also be non-stationary. Indeed, with exception of Romania, all countries exhibit non-stationarity in interest rate series. Here we tend to look at ADF test without linear trend, because it would be hard to justify the presence of a linear trend in the long run relationship which would imply eventually negative interest rates given the negative slope of the "trend" in the past six years.

In general ADF testing procedure shows that most analyzed series are I(1), with core inflation series being I(1) around linear trend.

5. Empirical Analysis of Transmission Mechanism and Cointegration

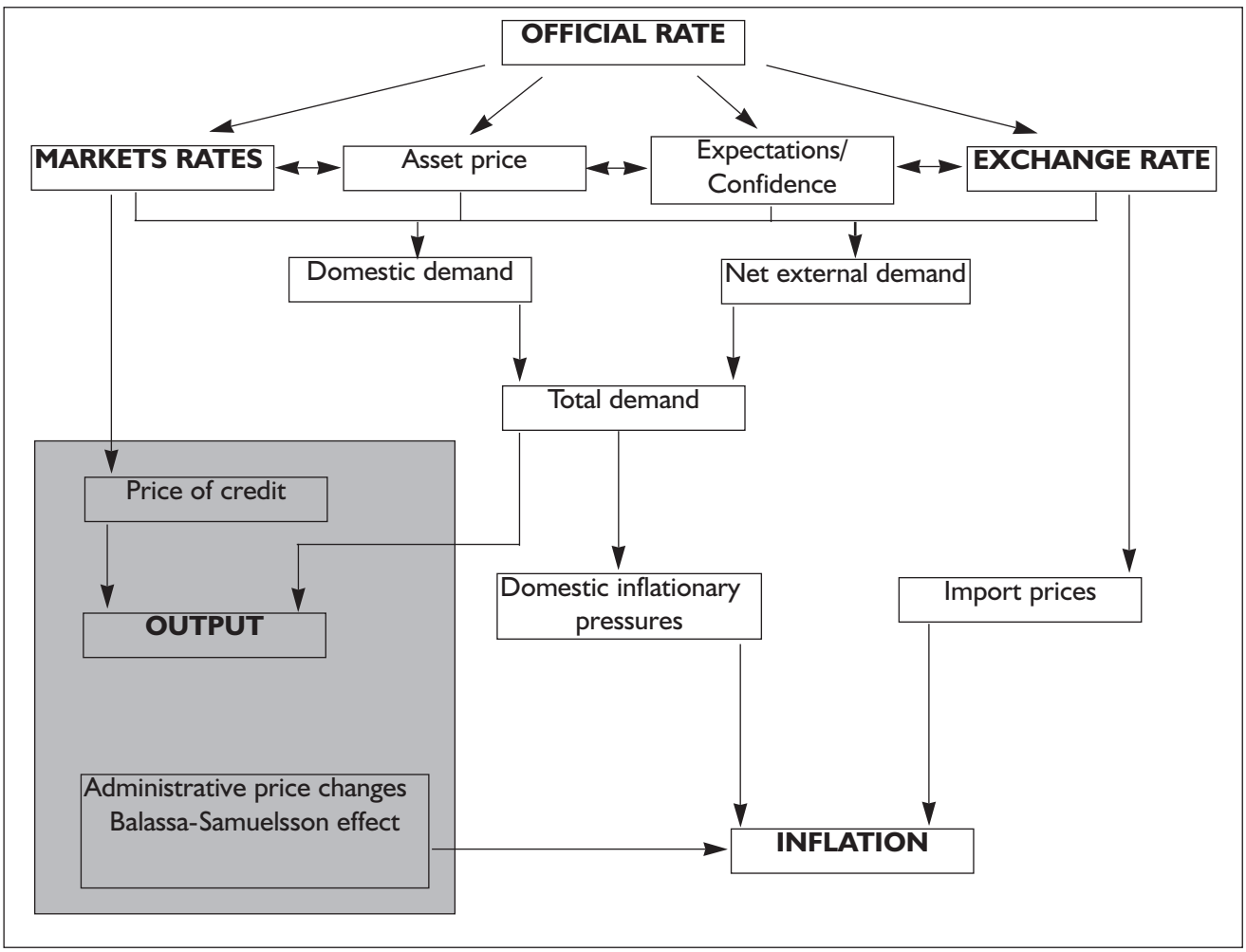
In this chapter we would like investigate selected issues related to transmission mechanism of monetary policy in the comparative context of 10 Central European countries. Without developing a rigorous structural model, we employ conventional techniques of Granger causality tests and generalized impulse responses to get some insight into the relative strengths of the most important channels and their performance across the region. Additionally we investigate issues related to cointegration in the context of a system of variables central to the analysis of transmission mechanisms.

5.1. Transmission Channels

The concept of transmission mechanism of monetary policy we employ is similar to that of the Bank of England's Monetary Policy Committee (Bank of England, 1999). Figure 2 presents the diagram depicting this exposition.

The diagram is augmented by several other channels that we drew over a grey square to distinguish them from the

Figure 2.The diagram of transmission mechanism of monetary policy based on Bank of England's exposition (Bank of England, 1999)



Source: Based on Bank of England (1999) with authors' additions (grey square).

original Bank of England's scheme. One purpose of these additions is to show how the specificity of transition economies may change/modify the mechanism. This distinctive character has been the common theme of many studies reviewed in chapter 2. Here we give two examples both concerning additional factors that influence inflation and both are present in the CEE economies to a much bigger extent than, for instance, in the European Union countries. One of them is the importance of administrative price increases to inflation outcomes. As noted in section 4.1 on core inflation, these price changes have undoubtedly led inflationary processes in post-socialist economies and still constitute a very important factor contributing to relatively higher inflation pressures. Another factor is the Balassa-Samuelsson effect stemming from higher productivity growth in the tradables' compared with nontradables' sector[19]. Both factors produce a substantial upward pressure on prices in transition economies.

In this paper we decided to restrict ourselves to studying two major transmission channels: exchange rate channel and interest rate channel and their pass-through on inflation and output. Far from describing the complete transmission mechanism, these channels are easily identifiable and are operating in all countries in the panel. Analysing other channels, such as expectations or credit channel, is likely to pose considerable problems with finding comparable data and making cross-country inferences.

Since our interest rate variable is the rate in the money market (MARKET RATES in the diagram), we are clearly skipping the first stage of transmission from OFFICIAL central banks RATES (such as refinance, discount or lombard rates). We are aware of the fact that the transmission from official to market rates is the factor that stands in between monetary policy actions and whatever pass-through to INFLATION and OUTPUT we identify. However, 3 out of 10 countries considered here have given up their monetary policy autonomy by adopting currency boards and thus have no means of setting "official" interest rates. Therefore, we decided to focus on the transmission from market rates to inflation and output with the implicit assumption that in non-currency-board countries the transmission process from central bank rates to market rates is fairly smooth and predictable. Thus, we assume that changes in market interest rates are triggered directly by changes in official interest rates through a relatively quick and effective pass-through and are thus a good proxy for official policy actions.

We begin our analysis by testing some key causality relationships postulated in theory, i.e. the causal relationship between both core inflation as well as industrial output and interest and exchange rates. We then proceed to analysing cointegration and impulse responses.

5.2. Granger Causality

We carried out conventional Granger causality tests to check whether interest rates moves and exchange rate depreciation have an effect on core inflation and industrial output. Variables (core inflation, industrial output and exchange rate indices) have been transformed to annual growth rates to match the interest rate which is expressed in annual terms.

Tests involve estimation of the regular Granger-type equation:

$$y_t = \alpha_0 + \sum_{i=1}^{l} \alpha_i y_{t-i} + \sum_{i=1}^{l} \beta_i x_{t-i}$$

and testing the hypothesis of no Granger causality from x to y as the Wald-test of joint insignificance of betas. In our case, in the first set of tests y was the annual rate of growth of core inflation index and x was the interest rate and the annual rate of growth of exchange rate (annual depreciation of domestic currency vis-à-vis the Euro). In the second set of tests y was the annual growth rate of industrial output and causing variables were the same.

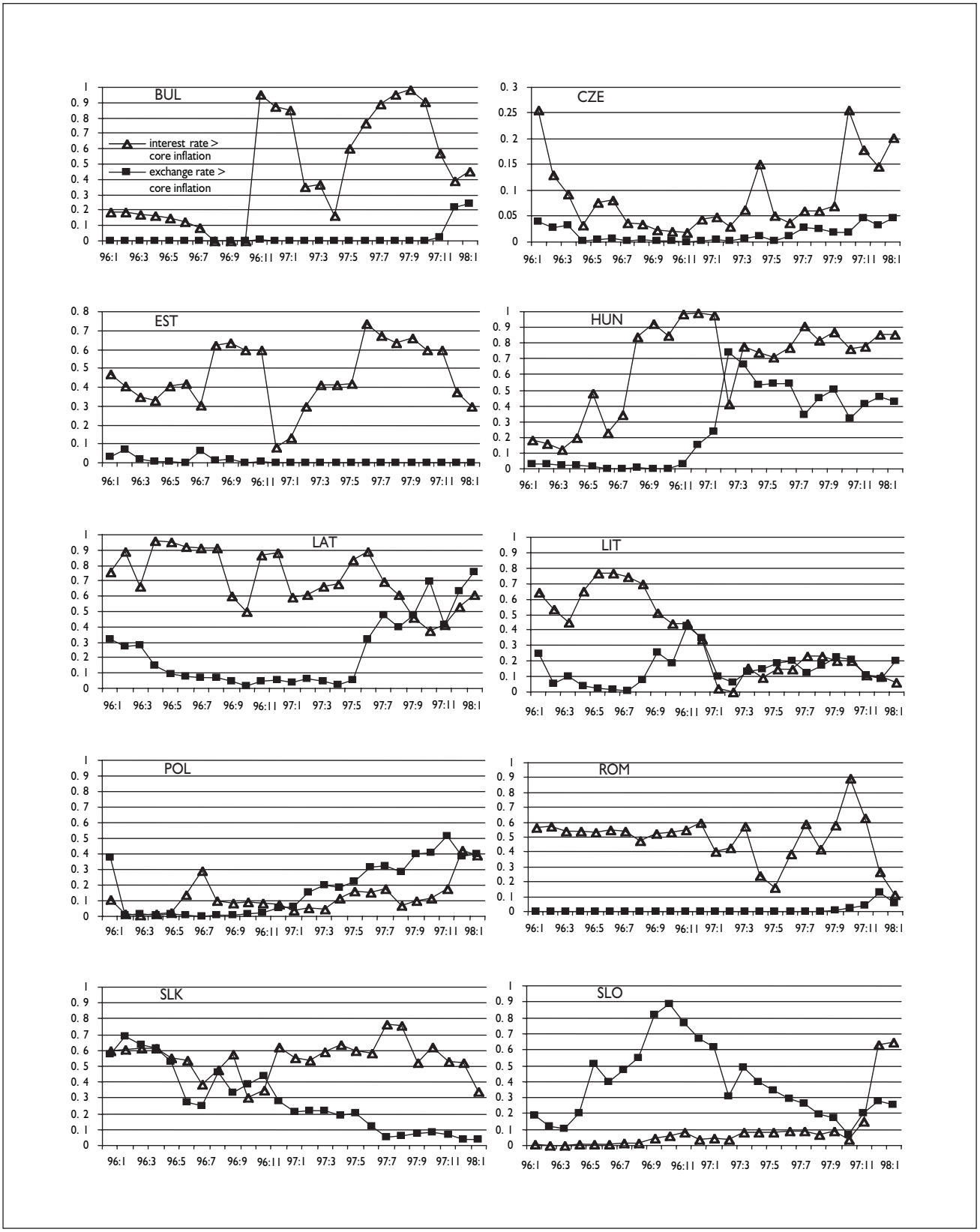
Tests were carried out in a 3-year rolling window to observe a dynamic pattern of postulated relationships. Starting with the sample: 1996:1-1998-12 and rolling it in one-month steps yielded 25 sub-samples and hence 25 test results. Results are presented in figure 3. Data points in the charts are p-values of the Wald F-statistics for tests conducted on a 36-month sample with the initial observation marked in the *X*-axis. Charts in figure 4 show analogous values for tests of the existence of causality running from interest rate and exchange rate to industrial output. We decided to choose common lag order for both sets of tests and for all countries to facilitate comparisons. Higher lag orders were also tested but did not introduce significant change to our results.

Granger tests clearly confirm previous results (many of which have been quoted in the review in chapter 2) on the relative importance of interest and exchange rate channels. For most countries exchange rate channel is much more stable than the interest rate channel. Domestic currency depreciation can be considered a Granger-cause for core inflation in Bulgaria, Czech Republic, Estonia and Romania. In Poland Latvia and Hungary the causality disappears past the period starting in the first half 1997. In Slovakia the relationship becomes significant towards the end of the sample and in Slovenia no causality from depreciation to inflation was detected.

[19] For a recent estimate of the Balassa-Samuelsson effect in CEE coutries, please see Egert (2002).

Figure 3. Interest rate>core inflation and exch. rate > core inflation Granger causality

(P-values from F-test on the null hypotesis of no-Granger causality. X-axis entries mark first observation of a 3-year rolling window). Exchange rate and industrial output expressed as 12-month growth rates.



Source: Autors' calculations.

Interest rate channel is much more unstable throughout the sample. Slovenia is the only country that seems to have had this channel operating in the entire period. Significant causality (at 10% confidence level) was detected for Poland and Czech Republic for most sub-samples and for remaining 7 countries causality became significant only sporadically (Lithuania, Bulgaria and Estonia) or was insignificant for the entire sample period (Hungary, Latvia, Romania and Slovakia).

Granger causality turned out significant less frequently in the industrial output equations. Here, too, depreciation influenced output more often than did the interest rate change. In the case of Czech Republic, Romania, Hungary and the Baltic countries, we can speak of significant causality in the majority of the samples. Much less so in the case of Bulgaria, Slovakia and Slovenia where significant causality running from exchange rate to output was rather rare.

Causality from interest rate to output on most subsamples was detected in Poland and Czech Republic. Causality in Romanian and Slovakian equations was present roughly in the first and second half of the sample, respectively. For all other countries, there is very little evidence of Granger causality running from interest rates to industrial output.

5.3. Cointegration Analysis

As a next step of our analysis we wanted to investigate the existence of cointegration in our set of data series for the analysed countries. For this purpose as well as for subsequent analysis we chose the following set of endogenous and exogenous variables widely recognized as crucial to understanding transmission mechanism in the macroeconomy. They are as follows:

Endogenous variables	Exogenous variables
Industrial output (*y*)	European Union industrial output
Exchange rate against the Euro (*x*)	European Union *PPI*
Short term interest rate (*i*)	Euro area interest rate (Bundesbank before 1999)
Core inflation index (p^c)	Constant, trend

Models with similar variables have been proposed in the literature, for example in the study by Garatt, Lee, Pesaran and Shin (1999) who additionally include real money balances in the above list. Our omission of money reflects the fact that money supply plays a far less significant role in monetary transmission mechanism than in developed economies amid low monetization. On the other hand, Granger causality tests from the previous section, stylised facts and literature on transmission mechanism in CEE suggests that exchange rate is the primary and quickest channel of monetary transmission. At the same time limited number of observations forced us to reduce the number of variables in the system.

We begin our analysis by checking for cointegration among the variables in the system. The shortcomings of residual based tests for cointegration are well known. The result could crucially depend on the choice of the left hand side variable. They do not allow for more than one cointegrating relationship and are not efficient, i.e. do not make the best possible use of available data. Another difficulty with the residual-based tests for cointegration lies in the fact that one must know with certainty that the underlying regressors in the model are *I(1)*. Given the uncertainties about the level of integration of several variables of interest (see ADF test results), we follow the ARDL approach developed by Pesaran, Shin and Smith (2001), which largely overcomes the problem mentioned above.

This ARDL approach consists of three steps. In order to check for cointegration between variables *x* and *y* the following ECM model is estimated:

$$\Delta y_t = \sum_{i=1}^{p} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{p} \theta_i \Delta x_{t-i} + \delta_1 y_{t-1} + \delta_2 x_{t-1} + error$$

Then, the usual F-statistic is computed for the joint significance of both δs, i.e. the null hypothesis is: $\delta_1 = 0$ and $\delta_2 = 0$.

The distribution of this F-test statistic is non-standard, critical value bounds are tabulated in Pesaran, Shin and Smith (2001). If the test value is above the upper bound of the critical values then we conclude that there exists a long-run relationship between *y* and *x*. If the test value is below the lower bound we conclude that there is no long-run relationship. If the test value falls between the two, the test is inconclusive.

We follow this procedure to check for the cointegration in our system by estimating the following equation:

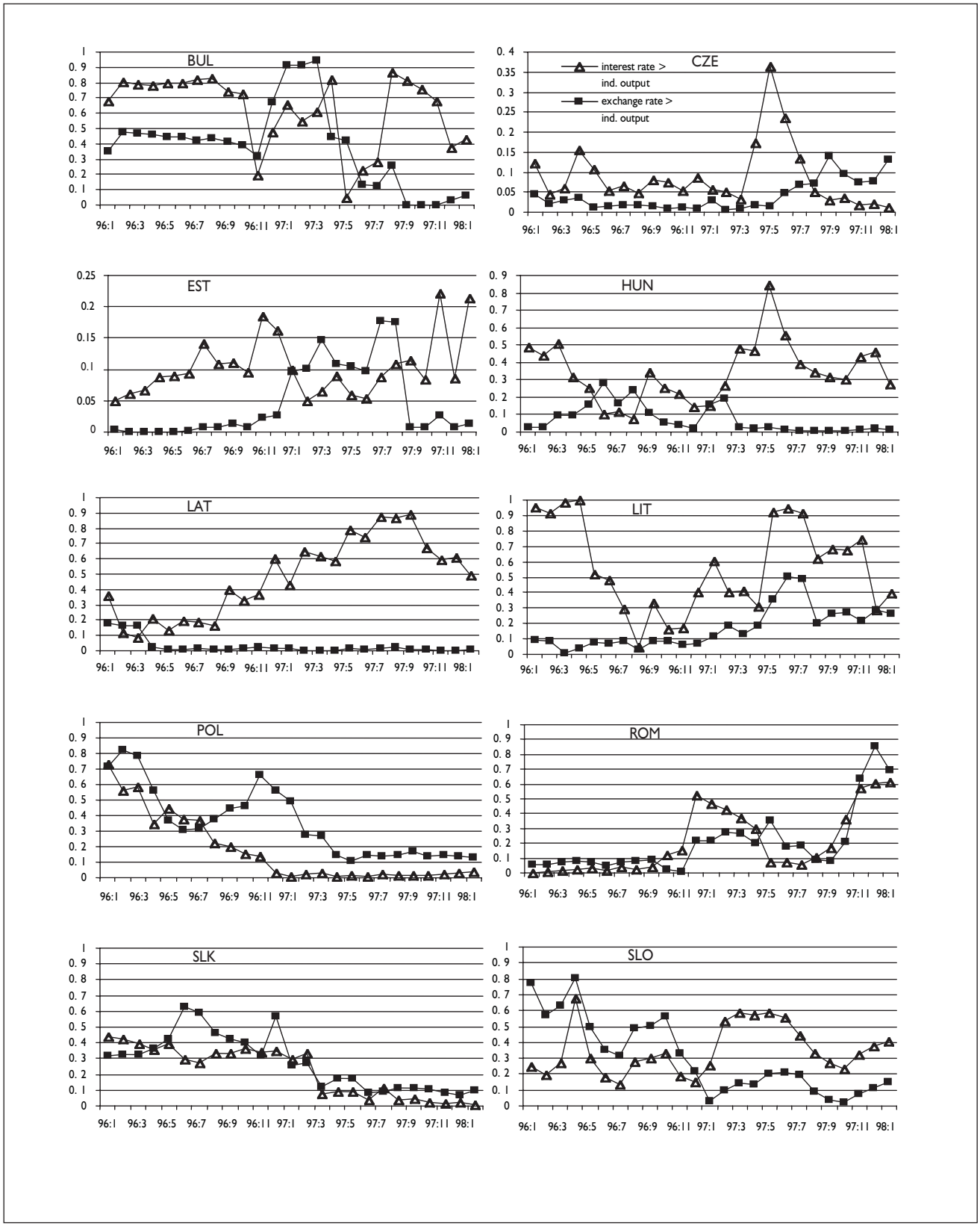
$$\Delta y_t = \sum_{i=1}^{p} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{p} \phi_{i1} \Delta p^c_{t-i} + \sum_{i=1}^{p} \phi_{i2} \Delta r_{t-i} + \sum_{i=1}^{p} \phi_{i3} \Delta i_{t-i} + \delta_1 y_{t-1} + \delta_2 p^c_{t-i} + \delta_3 r_{t-1} + \delta_4 i_{t-1} +$$
$$+ exogenous\ variables + error$$

where *y* refers to domestic industrial output[20], p^c – core inflation index, *r*– exchange rate and i – interest rate. Exoge-

[20] The choice of the left-hand side variable is not important for the test results.

Figure 4. Interest rate>ind. output and exchange rate > ind. output Granger causality.

(P-values from F-test on the null hypotesis of no-Granger causality. X-axis entries mark first observation of a 3-year rolling window). Exchange rate and industrial output expressed as 12-month growth rates.



Source: Autors' calculations.

Table 8. ARDL cointegration tests

Country	Lag order (SBC on unrestricted VAR)	ARDL F-test	Hypothesis of no long run relationship
Bulgaria	1	12.37	Rejected
Czech Republic	1	18.79	Strongly rejected
Estonia	2	3.47	Accepted#
Hungary	1	10.05	Rejected
Latvia	1	4.94	Marginally rejected##
Lithuania	4 or 1	4.39	Marginally rejected##
Poland	2	20.89	Strongly rejected
Romania	3	9.13	Rejected
Slovenia	3 or 1	3.21	Accepted
Slovakia	1	7.72	Rejected

Note: Lower and upper bounds of critical values in ARDL procedure for our sample are (3.21,4.37)

If all level variables are I(0) then there could still be long-run relationship. However as shown by ADF tests Estonian exchange rate against Euro is I(1)

Our regression has exogenous variables and critical values were simulated without such variables. Therefore distribution of critical values in our case would be shifted towards higher values

Source: Authors' calculations.

nous variables are presented in the above table and comprise EU industrial output and PPI, Eurozone interest rate in addition to trend and constant variables. The test statistic is the F statistic for the joint significance of all δs, i.e. $\delta_1=0$ and $\delta_2=0$ and $\delta_3=0$ and $\delta_4=0$

Number of lags (p) included in the equation is determined by estimating unrestricted VAR models for each country. Again, SBC criterion is used, because given scarcity of data more parsimonious models are preferred. In some cases (Romania, Slovenia, Poland, Estonia) tests based on the AI criterion strongly favored VAR order higher than SBC. For these countries we allowed for higher lag order. The chosen lag order and the resultant ARDL F statistic are presented in table 8.

As shown in table 8, we cannot reject the hypothesis of no long-run relationship for all countries with the exception of Slovenia and Estonia. Having determined this, we would like to learn more about the nature of the long-run relationship between industrial output, inflation, exchange rate and interest rates given external growth, inflation and interest rate conditions. We follow ARDL approach to cointegration proposed by Pesaran and Shin (1999). We set the maximum lag order to four and use Schwarz Bayesian Criterion to help us determine the lag structure. We will repeat this exercise also for Estonia and Slovenia despite rejection of the hypothesis of long-run relationship in those countries. It may be wrong from methodological point of view but will still be useful to see the results for comparative purposes.

We are also aware of the fact that we may not be able to detect the proper long run relationship on the basis of a 6-year-long sample of monthly data. However, this is a very common drawback in this type of analysis, further exacerbated by the presence of structural breaks in transition economies (for example: an introduction of the currency board in Bulgaria in the mid-point of the sample). Also, we decided not to introduce country specific dummies in the analysis. Using dummies would obviously boost explanatory power of the estimated models, but at the same time it would make cross-country comparisons impossible.

Results of the estimations for the model with industrial output on the left-hand side are presented in table 9. P-values based on asymptotic standard errors are in brackets. Last column presents estimate of the error correction mechanism in the error correction representation of the ARDL model. Model lag structure was determined by means of the SB criterion.

Long run relationship between exchange rate and growth turned out positive in 7 cases and negative in 3 cases. Among countries characterized by the negative relationship there is Estonia with a currency board and Czech Republic which experienced recession after forced crown devaluation in May 1997. Countries with currency boards (Bulgaria, Estonia) exhibit negative long-run relationship between growth and interest rates although the result is not statistically significant in the Estonian model. This negative correlation is consistent with our expectations, as countries with currency board arrangements do not have their own monetary policy and the only way to increase interest rates is to increase country risk premium. This in turn means capital outflow and contraction. In other cases (with the exception of Slovakia and Slovenia) higher output seems to be associated with higher interest rates.

A positive relationship between growth and core inflation was detected for 6 out of 10 countries. Empirical observations would suggest that in the long run prices should exhibit

Table 9. Estimated long run coefficients using ARDL approach (dependent variable – log of industrial output)

Country/ Variable	Model	Exchange rate (log)	Interest rate	Core price index (log)	ECM(-1)
Bulgaria	ARDL(0,3,0,2)	1.675 [0.000]	-0.113 [0.015]	-1.662 [0.000]	-1.000 [NONE]
Czech Rep.	ARDL(4,0,0,3)	-0.226 [0.051]	0.317 [0.134]	0.612 [0.000]	-1.888 [0.000]
Estonia	ARDL(1,0,0,0)	-3.713 [0.003]	-0.084 [0.859]	-0.322 [0.367]	-0.227 [0.018]
Hungary	ARDL(3,0,0,4)	-0.631 [0.736]	1.944 [0.580]	0.363 [0.806]	-0.315 [0.069]
Latvia	ARDL(1,0,0,0)	1.537 [0.035]	0.448 [0.625]	0.688 [0.357]	-0.352 [0.000]
Lithuania	ARDL(1,0,0,0)	1.561 [0.013]	0.869 [0.245]	1.195 [0.043]	-0.550 [0.000]
Poland	ARDL(2,0,0,0)	0.343 [0.001]	0.426 [0.000]	0.357 [0.000]	-0.889 [0.000]
Romania	ARDL(1,0,0,0)	0.133 [0.388]	0.040 [0.504]	-0.327 [0.006]	-0.519 [0.000]
Slovakia	ARDL(0,0,0,0)	0.100 [0.297]	-0.227 [0.140]	0.503 [0.000]	-1.000 [NONE]
Slovenia	ARDL(1,0,1,0)	1.602 [0.214]	-0.413 [0.327]	-1.090 [0.328]	-0.144 [0.101]

Source: Authors' calculations.

positive correlation with real growth. For example, with industrial output growing 5% per year on average and prices at 2% the coefficient on long run relationship would be around 0.4. Such statistically significant result was obtained only for Poland, Czech Republic and Slovakia. For example in Romania the long run coefficient is negative, which seems to reflect the country's experience, namely industrial output slumps during periods of high inflation. Of course, one would not expect such estimate to describe the true long-run relationship, but rather transitory phenomena that took place in a 6-year-long sample. Last column shows that all equations (except for Bulgarian and Slovakian ones) are strongly error-correcting, albeit around dubious long-run paths.

As expected, long-run relationships are very different among countries, some clearly not reflective of the true long run behavior of analyzed variables. It appears that the simple model we used does not recognize the long-run very well. It is also very likely that at this stage, when in most countries, not a single full business cycle has been observed yet, the true long-run relationship cannot be detected. Obviously, more country-specific approach is required. For example, models for Bulgaria should include a dummy variable for a period of CBA and in other countries frequent exchange rate regime shifts and monetary policy rules changes should be taken into account. This surely goes beyond the scope of this simple comparative analysis.

In the next step of our cointegration analysis we would like to find out how many long run relationships one can detect for each of the analyzed countries in a cointegrating VAR framework. As shown in the ARDL approach to cointegration (see table 8), in case of Estonia and Slovenia we could not reject a hypothesis on no long-run relationship, however we include those two countries into the computations for illustrative purposes.

Table 10 presents the results of the cointegration rank tests based on Johansen's log-likelihood trace and maximum eigenvalue statistics. Both tests are run in two versions, with and without trends. They yield very similar results.

Before commenting the results we note that on the basis of economic theory one should expect two long-run relationships: one based on the Purchasing Power Parity (PPP) and the other one reflecting the Uncovered Interest Parity (UIP)[21]. Because our model includes both foreign and

Table 10. Results of Cointegration Rank Tests (Maximum Eigenvalue and Trace)

Number of long-run relationships according to Johansen's log-likelihood-based trace and maximum eigenvalue statistics.

Country	Form of the model tested	Restricted intercepts and no trends		Unrestricted intercepts and restricted trends	
	Test statistic	Maximum Eigenvalue	Trace	Maximum Eigenvalue	Trace
Bulgaria		3	3	2	2
Czech Rep.		2	2	2	2
Estonia		1	2	3	3
Hungary		3	3	2	2
Latvia		1	1	1	1
Lithuania		1	1	1	1
Poland		3	3	3	3
Romania		2	2	2	2
Slovakia		2	2	2	2
Slovenia		4	4	1	3

Source: Authors' calculations.

[21] For example of such model estimated for UK see Johansen and Juselius (1992) and Pesaran, Shin, Smith (2000).

domestic growth rates (of industrial output) we could also argue that in the long run these rates should converge. Indeed it is hard to imagine that in the long-run (say 50 years) average growth rate of one EU member would substantially differ from a growth rate of another member. This creates room for the third possible long-run relationship, but it is unlikely that such a long-run restriction would be accepted in light of the past data. Also in the coming years we expect a catching up effect before the long-run equilibrium will be established.

As table 10 suggests, indeed for most analyzed countries we found 2 or 3 long-run relationships. Latvia constitutes an exception with 1 relationship, while Slovenia and Estonia show different results depending on the model or statistics used. Please note that in the ARDL F-test conducted earlier in these three cases we found either no long-run relationship, or it was only marginally rejected.

Above results confirm that for a reduced sample of countries there is a possibility to estimate a cointegrating VAR and impose restrictions suggested by economic theory but this task goes beyond the scope of this paper.

5.4. Generalized Impulse Responses

To conclude our study we conduct impulse response analyses for the group of countries under investigation. Most common approach is the use of orthogonalized impulse responses often referred to as Sims approach. However, its major drawback are severe restrictions on variables imposed through assuming particular ordering. In order to circumvent this problem, the concept of generalized impulse responses (GIR) has been proposed by Koop, Pesaran and Potter (1996) and applied to VAR models by Pesaran and Shin (1998). GIR are computed by subjecting a selected equation to a one-standard-deviation forecast error shock, and simultaneously all other equations proportionally to correlation of residuals in a selected equation and other equations. This approach implies that if some variable moves simultaneously with our instrument variable, we do not force this correlation to zero (as sometimes happen in Sims approach), but explicitly allow for simultaneous shock in this variable equal to the correlation coefficient. Therefore in GIR approach ordering does not matter. We basically take a look at the interactions of the data without making any use of economic theory and without imposing any restrictions. Below we present and briefly analyze the two most interesting transmission channels: exchange rate and interest rate.

Charts in figure 5 present generalized impulse responses of industrial output, exchange rate and core inflation to a one-standard-error interest rate shock for all analyzed countries. Charts in figure 6 present analogous responses to a one-standard-deviation exchange rate shock. Because of hyperinflation periods in Bulgaria and Romania during the sample period, impulse responses for those countries are much bigger in magnitude and therefore are depicted in a separate chart.

Positive short-term-interest-rate shock brings about very different reactions of industrial output in different countries. It dampens output in the short run in Slovakia (SLK), Hungary (HUN) and Slovenia (SLO) while it raises it in Lithuania (LIT), Estonia (EST), Czech Republic (CZE) and Poland (POL). Latvia (LAT), Bulgaria (BUL) and Romania (ROM) have a mixed pattern. The impact seems to die out after 12 months for most countries.

The response of exchange rate to the interest rate shock was only calculated for those countries that have a currency regime allowing for exchange rate variation. Among these countries, in Slovakia, Slovenia and Poland the interest rate shock brings about initial depreciation followed by appreciation of the currency. Romania experiences persistent appreciation and Czech Republic – depreciation. Hungary exhibits a switching pattern with longer-run appreciation.

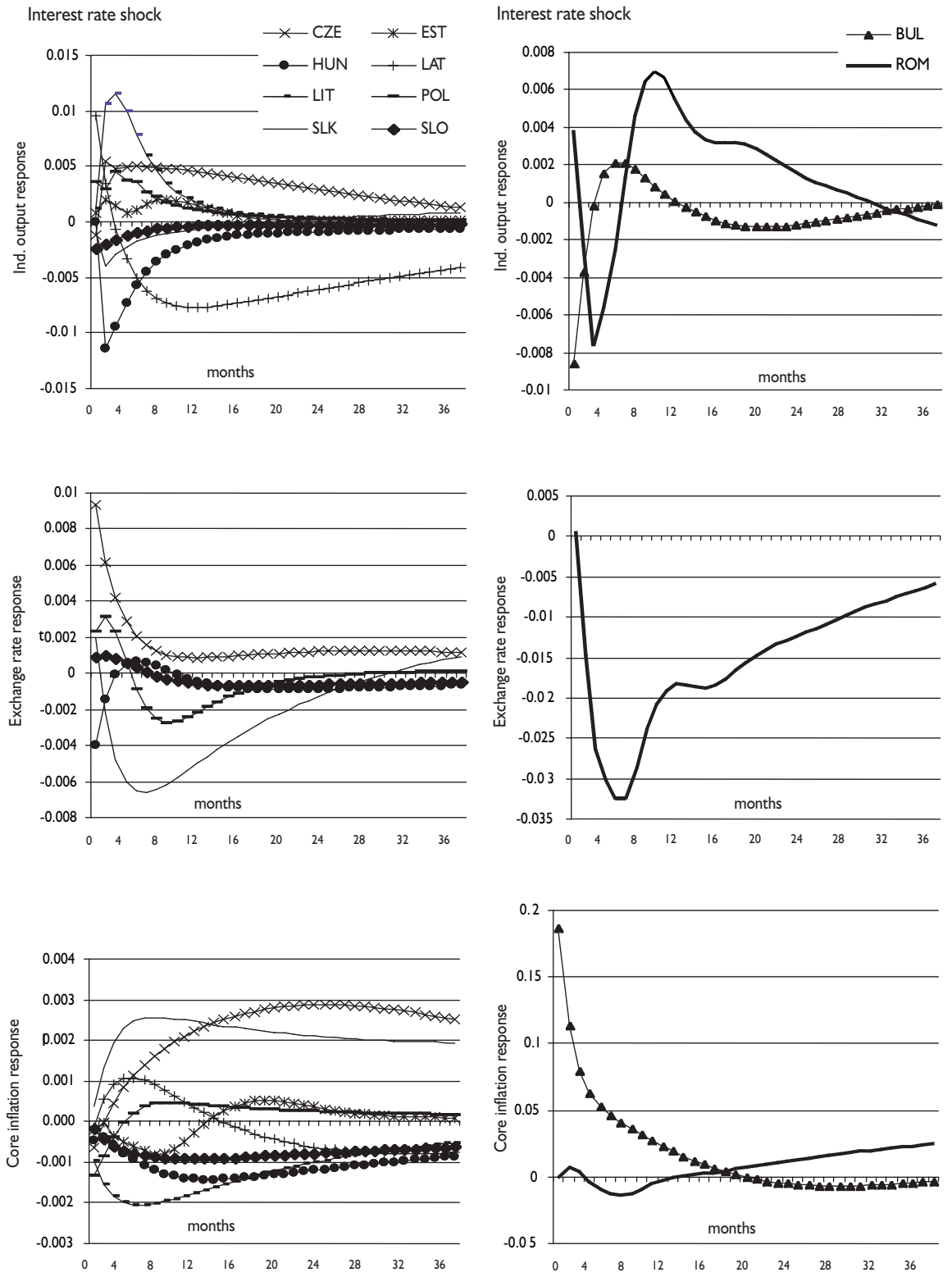
Core inflation response to interest rate shocks varies across countries. In some of them, e.g. Lithuania, Hungary and Slovenia, the response is consistent with the theory, i.e. higher interest rates dampen inflation. In Bulgaria after initial boost, inflation subsides. In Slovakia and Czech Republic interest rate shock raises inflation persistently which leads to higher inflation even after 3 years following the shock. In Romania, apparently, there is an instability problem – core inflation is still on the rise after 3 years.

Positive exchange rate shocks (equivalent to one-time depreciation) seem to boost industrial output in most countries in the short run. This influence generally disappears after 12-18 months (Latvia is the exception). In Romania, Bulgaria and Estonia domestic currency depreciation vis-a-vis the Euro lowers output and it takes up to 3 years for this effect to disappear.

Responses of the short term interest rates to the depreciation shock have similar patterns across most countries: in the first 2-5 months following the shock, interest rate rises and then starts to fall. In some countries (Romania, Estonia, Slovenia) disturbances to interest rate oscillate further before stabilizing at 0 after 24 months. For most countries, the disturbance disappears after 2 years. Only in the case of Latvia (again), the shock has persistent effects and keeps the interest rate below the initial level for longer than 36 months. This points to possible instability of the Latvian system estimated here.

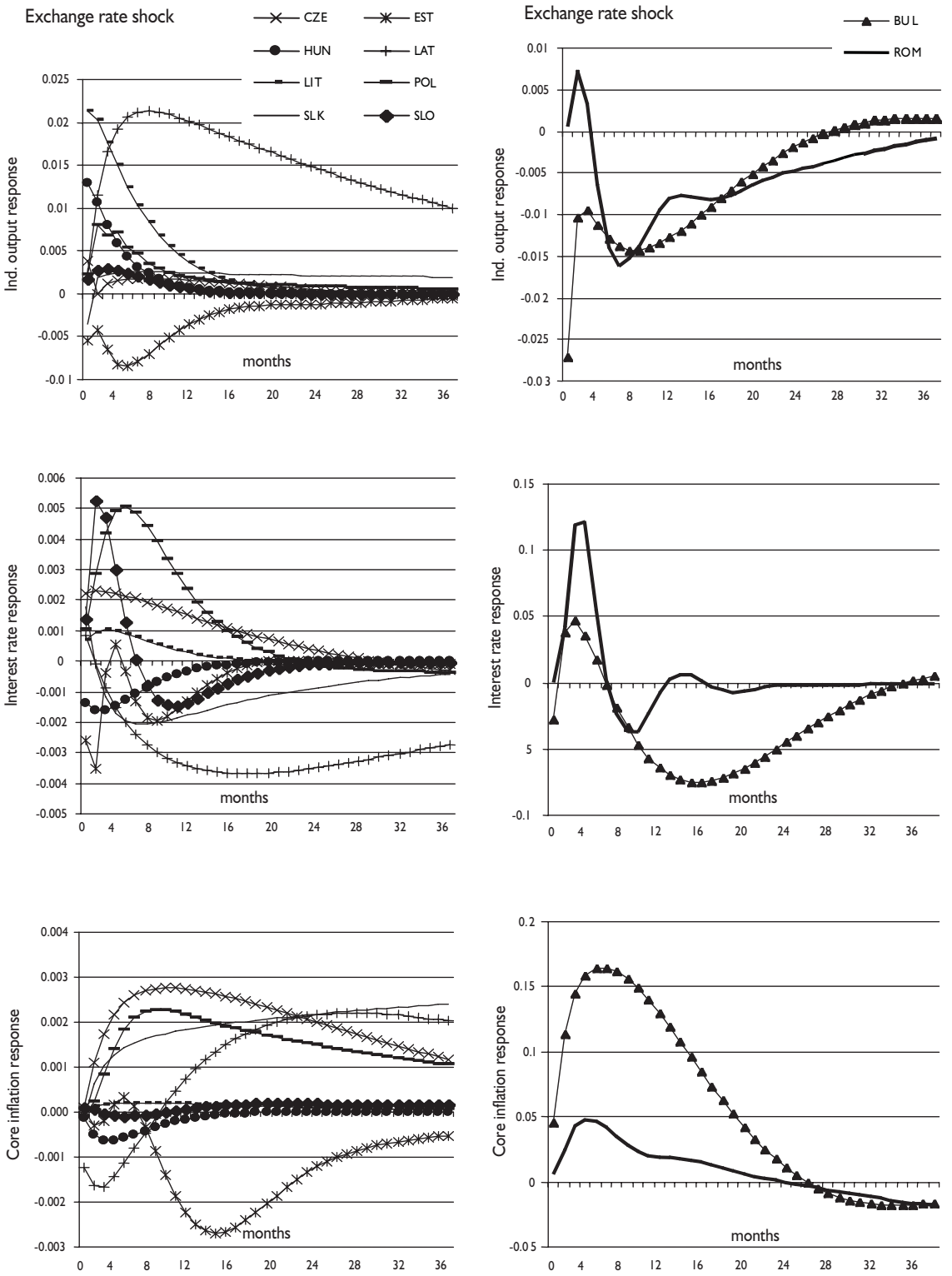
Depreciation shock fuels core inflation in most countries. The effect is sizeable in Slovakia, Latvia, Czech Republic and Poland and seems to persist even after 36 months. The impact is also big in Bulgaria and Romania (both had hyperinflation episodes in the sample), but starts to decline after approximately half a year to fall slightly below 0 after 2 years. Core inflation does not seem to be significantly influenced by deprecation in Hungary, Slovenia and Lithuania.

Figure 5. Generalized impulse responses to one-standard-error shock in the interest rate equation



Source: Authors' calculations.

Figure 6. Generalized impulse responses to one-standard-error shock in the exchange rate equation



Source: Authors' calculations.

6. Summary and Conclusion

As more central banks across Central and Eastern Europe (CEE) move towards inflation control – either in the form of direct inflation targeting or indirectly through informal targets – good knowledge of transmission mechanism in the economy becomes crucial for implementing good policies. So far the volume of studies in the region devoted to this issue is not overly impressive. Specifically, there have been no attempts made to study the issue in a comparative context of several economies. We wanted to fill this gap by investigating transmission mechanism using the same methodology for 10 CEE countries: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

We started our paper by reviewing literature related to transmission mechanism of monetary policy in CEE countries. In the case the region concerned, this research field, like many others, is naturally constrained by at least two important factors. The first is the lack of data in terms of both length of time series and of quality and reliability. The second is constant institutional changes in the studied countries which renders the different models and techniques structurally unstable and the results – generally volatile. The review we provide is probably one of the most comprehensive and up-to-date review of transmission mechanism for the region of CEE.

In the following chapter of our paper we presented a discussion on various issues related to transmission mechanism of monetary policy. The narrative description was meant to shed some light on how the process of transition might impact the various transmission channels, i.e. in what way are CEE countries different as far as the analysis of transmission is concerned. The main conclusion of the chapter was that during transition the environment in which monetary policy was conducted was far from "neoclassical" conditions. With respect to the formal analysis of monetary transmission in these countries during this period, at least two important observations need to be emphasized.

The first one is that some specific constraints and behavioral incentives in the transition context may render traditional policy tools less effective than a neoclassical environment would suggest. During transition, the institutions which are important for the effectiveness of monetary policy are underdeveloped by definition, while processes hampering monetary transmission (budget deficits, bad loans, various predatory projects) may be very strong or even dominant at times. This environment may even force the monetary authority itself into inconsistent actions, decreasing their effectiveness even further.

The second observation is that transition is a very dynamic phenomenon, which was subject to constant qualitative change in all reviewed countries since the early 1990s. Structural change was observed throughout the period and thus the underlying environment of the data was changing and was not homogeneous for the period. It may be claimed that towards the end of the observed period the monetary environment was much closer to Western standard conditions than in the beginning. Thus all countries have experienced at least one structural break, with later periods more favorable for formal analysis than earlier ones.

Following the narrative part we proceeded to the empirical analysis. Because inflation behavior is central to analysis of transmission mechanism, the choice of inflation indicator is very important to subsequent research. In view of considerable noise in price data during transition we decided not to use the conventional CPI. Rather, we made use of core inflation indices that are less prone to short term reversible supply shocks and thus better indicate the general price trend. However, no single core inflation definition prevails and so we had to choose among several available series for each countries. We based the selection process on the commonly used criteria, such as stability, unbiasedness, attraction and exogeneity. Inflation as well as other variables used in subsequent analysis (industrial production, interest rates, euro exchange rates) were first checked for the level of integration and then crucial interactions among the variables were investigated.

In this paper we decided to restrict ourselves to studying two major transmission channels: exchange rate channel and interest rate channel and their pass-through on inflation and output. Far from describing the complete transmission mechanism, these channels are easily identifiable and are operating in all countries in the panel. Analysing other channels, such as expectations or credit channel, is likely to pose considerable problems with finding comparable data and making cross-country inferences.

We began our analysis by testing conventional Granger causality to find out to what extend interest rates and exchange rates have an impact on inflation and output. To capture the dynamic pattern of the relationships we run the tests in a 3-year rolling windows. The analysis confirmed previous findings about on the relative importance of interest and exchange rate channels. For most countries exchange rate channel is stronger and much more stable than the interest rate channel.

As a next step we tried to find cointegration in the system of 4 above-mentioned augmented by European Union producer price index, industrial output and interest rates. For all countries except Estonia and Slovenia we found evidence of the exsitence of cointegrating relationships which suggests that there is a systematic interaction between variables in the long run . Further tests indicated that we could identify 2 or 3 such relationships depending on the country.

Empirical analysis was concluded by investigation of impulse response functions that shed light on how inflation and industrial output reacted to surprise changes in key policy variables, i.e. interest rates and exchange rates. For most countries, again, responses of inflation were consistent with the theory, i.e. it was dampened by interest rate rise and boosted by exchange rate depreciation. Output was boosted by depreciation in the majority of countries while other respones strongly vary by country.

Reference

Árvai Zs. (1998), "Interest Rate Transmission Mechanism Between Market and Commercial Bank Rates in 1992-1998", NBH Working Paper, 1998.

Árvai Zs., P. Menczel (2000), "Savings of Hungarian Households, 1995-2000", NBH Working Paper, 2000/8.

Babich V. (2001), "Monetary Transmission in Latvia", Baltic Economic Trends 2001:2, pp. 16-28.

Bai J., B. Perron (1995), "Estimating and Testing Linear Models with Multiple Structural Changes", UNIVERSITE DE MONTREAL, Working Paper 95:52.

Balino T., J. Dhawan, V. Sundararajan (1994), "The Payments System Reforms and Monetary Policy in Emerging Market Economies in Central and Eastern Europe", IMF Working Paper WP/97/124.

Bank of England (1999), "The Transmission Mechanism of Monetary Policy", Paper by the Monetary Policy Committee, April 1999, http://www.bankofengland.co.uk/montrans.pdf.

Bole V. (1999), "Obrestni kanal monetarnega transmisijskega mehanizma 1992-1995 (Interest Rate Channel of Monetary Transmission Mechanism 1992-1995)", [in]: Teorija in praksa obrestnih mer eds. Borak Neven, Savin Davor, Ljubljana, Zveza Ekonomistov Slovenije: Inštitut za novejšo zgodovino, Collection: Ekonomska knižnica, 1999, pp. 77-89.

Bradesko J. (1996), "Ekonometrièni model denarnega multiplikatorja" (Econometric Model of the Money Multiplier), Bank of Slovenia Research Department, Monetary Analyses, March 1996.

Cecchetti S.G. (1996), "Measuring Short-Run Inflation for Central Bankers", National Bureau of Economic Research, NBER Working Paper No. 5786.

Csajbók A., L. Varró (2000), "Interest rate policy within a crawling band regime? An attempt of estimating a monetary reaction function", National Bank of Hungary, unpublished manuscript.

Csermely Á., L. Varró (2000), "The Crawling Band Regime: a monetary framework for gradual disinflation", National Bank of Hungary, unpublished manuscript.

Christoffersen P., R. Wesctott (1999), "Is Poland Ready for Inflation Targeting?", IMF Working Paper WP/99/41.

Corker R., C. Beaumont, R. van Elkan, D. Iakova (2000), "Exchange rate regimes in selected advanced transition economies - coping with transition, capital inflow and EU accession", IMF Policy Discussion Paper PDP/00/3, April 2000.

Delakorda A. (2000), "Monetary Policy in a Small-scale Economic Model", Bank of Slovenia Research Department, Monetary Analyses, July 2000.

Derviz A. (2000), "Monetary Transmission and Asset-Liability Management by Financial Institutions in Transitional Economies - Implications for Czech Monetary Policy", Czech National Bank Working Paper 22-00.

Dobrescu E., C. Mereuta (2001), "The Financial Blockage of the Romanian Economy", second part, Romanian Journal of Economic Forecasting 1/2001, Expert Publishing House.

Dovciak P. (1999), "Transmission Mechanism Channels in Monetary Policy", National Bank of Slovakia Research Publication DOV/0008.

Drenovec F. (1999), "Kakšen je transmisijski mehanizem v Sloveniji" (What Is the Transmission Mechanism in Slovenia Like), Bank of Slovenia Research Department, Monetary Analyses, December 1999.

Egert B. (2002), "Investigating the Balassa-Samuelson hypothesis in transition: Do we understand what we see?", BOFIT Discussion Papers, No. 6, Bank of Finland.

European Central Bank (2000), "Monetary Policy Transmission in the Euro Area", Monthly Bulletin, July 2000, pp. 43-58.

Fischer S. (2001), "Exchange rate regimes: is the bipolar view correct?", Distinguished Lecture on Economics in Government, American Economic Association annual meeting, New Orleans, January 2001.

Freeman D.G. (1998), "Do Core Inflation Measures Help Forecast Inflation?", Economic Letters 58, pp. 143-147.

Garcia-Herrero A. (1997), "Monetary impact of a banking crisis and the conduct of monetary policy", IMF Working Paper WP/97/124.

Garratt A., K.C. Lee, M.H. Pesaran, Y. Shin (1999) "A Long Run Structural Macroeconometric Model of the UK", University of Cambridge DAE Working Paper No. 9812, Revised, October 1999.

Gospodinov N. (1994), "Econometric Approach to the Long-Run Equilibrium of the Economy and the Demand for Money", [in]: "Economic Transition in Bulgaria", Agency for Economic Coordination and Development, Bulgarian Council of Ministers, Sofia, 1994, pp. 57-76.

Hampl M., R. Matoušek (2000), "Credit Contraction in the Czech Republic: Causes and Effects", Czech National Bank Working Paper 19-00.

Izak V. (1998), "Monetary Transmission Mechanism (Lending Channel)", Czech National Bank, Working Paper 90-98.

Jakab Z., Gy. Szapáry (1998), "Exchange Rate Policy in Transition Economies: the Case of Hungary", J. Of Comparative Economics, 26, December 1998, pp. 691-717.

Johansen S., K. Juselius (1992), "Testing structural hypotheses in a multivariate cointegration analysis of the PPP and UIP for UK", Journal of Econometrics 53.

Kominkova Z. (1999), "Monetary and Exchange Rate Policy in Slovakia", National Bank of Slovakia, Working Paper KOM/0036.

Kominkova Z. (1999), "Main Trends and Development in the Money Supply of Slovakia During 1998 and the First Half of 1999", National bank of Slovakia, Working Paper KOM/0038.

Komulainen T., J.Pirttila (2000), "Fiscal Explanations for Inflation: Any Evidence from Transition Economies?" Bank of Finland Institute for Economies for Transition (Bofit), Discussion Paper 2000 No. 11.

Koop G., H. Pesaran, S.M. Potter (1996), "Impulse Response Analysis in Nonlinear Multivariate Models", Journal of Econometrics, 1996, Vol. 74 No.1, pp.119-147.

Korhonen I. (1999), "Currency boards in the Baltic countries: what have we learned?", Bank of Finland Institute for Economies for Transition (Bofit), Discussion Paper 1999 No. 6.

Košak M. (1999), "Ugotovljanje likvidnostnega uèinka z uporabo modela vektorskih avtoregresij" (Examination of Liquidity Effect by Means of Vector Autoregression Model), [in:] Teorija in praksa obrestnih mer, (eds.) Borak Neven, Savin Davor, Ljubljana, Zveza ekonomistov Slovenije: Inštitut za novejšo zgodovino, Collection: Ekonomska knižnica, 1999, pp. 123-154.

Košak T. (1998), "Modeliranje prilagajanja kratkosroènih posojilnih obrestnih mer obrestni meri Banke Slovenije: model korekcije napak (ECM)" (Modelling Tools for Convergence of Short-Term Interest Rates to the Short-Term Interest of the Bank of Slovenia: Error Correction Model). Bank of Slovenia Research Department, Monetary Analyses, December 1998.

Lättemäe R. (2001), "Monetary Transmission Mechanism in Estonia", Working Papers of Eesti Pank, No. 4, 2001.

Lättemäe R., R. Pikkani (2001), "The Monetary Transmission Mechanism in Estonia", Baltic Economic Trends, 2001:2, pp. 7-15.

Lutkepohl H. (1993), "Introduction to Multiple Time Series Analysis", Springer-Verlag, Berlin.

Mahadeva L., K. Šmídková (2001), "What Is the Appropriate Rate of Disinflation to Be Targeted in the Czech Economy?", Czech National Bank, Working Paper 33-01.

Maliszewski W. (1999), "The Role of Monetary Policy in Poland: A VAR Approach", Paper presented at a ING-Barings conference in Warsaw in Dec. 1999.

Masson P. (1999), "Monetary and exchange rate policy of transition economies of Central and Eastern Europe after the launch of the EMU", IMF Policy Discussion Paper PDP/99/5, July 1999.

Marques C.R., P. D. Neves, A. Goncalves da Silva (2000), "Why should Central Banks avoid the use od the underlying inflation indicator?", Banco de Portugal, Banco de Portugal Working Paper WP 5-00.

Marques C.R., P.D. Neves, L.M. Sarmento (2000), "Evaluating Core Inflation Indicators", Banco de Portugal, Banco de Portugal Working Paper WP 3-00.

Mishkin F.S. (1995), "Symposium on the Monetary Transmission Mechanism", Journal of Economic Perspectives, Vol. 9 (4), Fall 1995, pp 3-10.

Nenovsky N., K. Hristov (1998), "Financial repression and credit rationing under currency board arrangement in Bulgaria", Bulgarian National Bank Discussion Paper No. 2, September 1998.

Nenovsky N., K. Hristov (1999), "Monetary regimes and real economy (an empirical test before and after the introduction of a currency board in Bulgaria)", Bulgarian National Bank, Discussion paper No. 10, August 1999.

OECD Report, 2000-2001 Annual Review - Czech Republic, 15-May-2001.

Pelinescu E., C. Scutaru (2000a), "Econometric Analysis of the Effects of Indirect Monetary and Foreign Exchange Policy Instruments", Institut for Economic Forecasting-Economic Performance Evolution in Transitional Systems, April 20, 2000, Internet Securities Inc., ISI Emerging Markets, http:www.securities.com

Pelinescu E., C. Scutaru (2000b), "An Econometric Model for the Analysis of Money Demend and Inflation in Romania", Institut for Economic Forecasting- Economic Performance Evolution in Transitional Systems, August 20, 2000, Internet Securities Inc., ISI Emerging Markets, http:www.securities.com

Perron P. (1989), "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis", Econometrica 57, 1361-1401.

Pesaran M.H., Y. Shin (1998), "Generalized Impulse Response Analysis in Linear Multivariate Models", Economics Letters, 1998, Vol. 58, pp.17-29.

Pesaran M.H., Y. Shin (1999), "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis, Chapter" [in:] S.Strom (ed.), "Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium", Cambridge University Press, Cambridge.

Pesaran M.H., Y. Shin, R.J. Smith (2000), "Structural Analysis of Vector Error Correction Models with Exogenous I(1) Variables", Journal of Econometrics, 2000, Vol. 97, pp.293-343.

Pesaran M.H., Y. Shin, R.J. Smith (2001), "Bounds testing approaches to the analysis of level relationships", Journal of Applied Econometrics, 2001, Vol. 16, No. 3, pp.289-326.

Petrov B. (2000), "Bank reserves dynamics under a currency board", Bulgarian National Bank, Discussion paper No. 15, August 2000.

Pikkani R. (2000), "The Monetary Sector Under a Currency Board Arrangement: Specification and Estimation of a Model With Estonian data", Working Papers of Eesti Pank, No. 4, 2000 (also BOFIT Online 2000 No. 10).

Pikkani R. (2001), "Monetary Transmission Mechanism in Estonia - Empirical Model", Working Papers of Eesti Pank, No. 5, 2001.

Popa C. (1996), "Constrangeri si efecte ale politicii monetare in Romania".

Pujol T., M. Griffiths (1996), "Moderate Inflation in Poland: A Real Story", IMF Working Paper WP/96/57.

Reluga M., K. Rybiński (1999), "Direct Inflation Targeting in Poland. Success or Failure", Paper presented at a ING-Barings conference in Warsaw in Dec. 1999.

Rybiński K. (1997), "Testing Integration of Macroeconomic Time Series in Transitional Socialist Economies. A Modification of Perron Test", Ace Project Memoranda Series, Department of Economics, University of Leicester.

Rybiński K. (2000), "The impact of monetary policy on the disinflation process in Poland" (Wpływ polityki pieniężnej na process dezinflacji w Polsce), Paper presented at the conference of the National Bank of Poland in June 2000.

Sarajevs V. (2000), "Econometric Analysis of Currency Substitution: a Case of Latvia", Bank of Finland Institute for Economies for Transition (Bofit), Discussion paper 2000, No. 4.

Vetlov I. (2000), "Analysis of Inertia in Lithuanian Inflation", [in:] Monetary Studies (publication of the Bank of Lithuania), Vol. 4, No. 3, September 2000.

Vetlov I. (2001), "Aspects of Monetary Policy and the Monetary Transmission Mechanism in Lithuania", Baltic Economic Trends, 2001:2, pp. 29-37.

Tóth I. J., Zs. Árvai (2001), "Liquidity Constraints and Consumer Impatience", NBH Working Paper 2001/2.

Ugolini P. (1996), "National Bank of Poland - The Road to Indirect Instruments", IMS Occasional Paper 144.

Világi B., J. Vincze (1998), "The interest rate transmission mechanism in Hungary, 1991-1995", [in:] L. Halpern and C. Wyplosz (eds.), "Hungary: Towards a Market Economy", Cambridge University Press, Cambridge, UK.

Woźniak P. (1998), "Relative Price Adjustment in Poland, Hungary and Czech Republic. Comparison of the Size and Impact on Inflation", CEU-CASE Working Paper Series 12, Budapest-Warsaw.

Wrobel E. (1999), "Mechanizm transmisji w Polsce w latach 1992-1999" (Transmission mechanism in Poland 1992-1999), Paper presented at a ING-Barings conference in Warsaw in Dec. 1999.

Ziacik T. (2000), "An Assessment of the Estonian Investment Climate: Results of a Survey of Foreign Investors and Policy Implications", Bank of Finland Institute for Economies for Transition (Bofit), Discussion paper 2000 No. 3.

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